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BIRD-BANDING

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BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. XIV JANUARY AND APRIL 1943 NO. 1 AND 2

HOMING INSTINCT IN THE DWARF COWBIRD IN ARIZONA

By JOHNSON A. NEFF

During the summer of 1942 Carlos Stannard, Phoenix, Arizona, citrus grower and bird bander, cooperated actively with the writer on certain phases of an official field assignment at his home which lies near Camelback Mountain some nine miles northeast of the State Capitol Building. During the first three weeks of May I spent considerable time at the Stannard ranch assisting him in the early phases of the work, and during the time assisted in the banding of numbers of birds, including many Dwarf Cowbirds (*Molothrus ater obscurus*).

The homing instinct of the cowbird has aroused the interest of a number of banders and bird students but to present date there has been no report on this phenomenon in the arid Southwest. Since cowbirds were so numerous as to be a nuisance about the traps, to say nothing of their depredations on the nests of other birds of the area, it was suggested that we transport some of them away from the Stannard ranch to study their homing qualities in the desert.

Beginning on May 13, 1942, cowbirds in varying numbers were taken from the traps and released at distances ranging from 4 to 110 miles. Due to the rubber situation travel was curtailed and trapped cowbirds were placed in a large holding cage where they readily took food and water until such time as there was opportunity to transport them. The liberations were made by Stannard, the writer, and some five or six other interested individuals, along routes where normal duties required their presence; no special trips were made for the purpose of liberating cowbirds.

Demands upon Stannard's time occasioned by ranch duties occasionally made it necessary for him to close his traps for from one to three days; furthermore, his traps are never operated during the heat of the day in the hotter portion of summer, but are opened for action only during the morning and late afternoon. Some of the recoveries may thus have occurred some time after the individual cowbird in question arrived back at the traps. May 13, the beginning date, is also quite late in the normal breeding season of the species in Arizona. Even with these disadvantages, some interesting results were obtained.

Cowbirds have been present in some numbers each season since Stannard began banding, and a total of 51 had been banded during the period 1937 to 1941, inclusive. Of these, eighteen had returned in succeeding seasons, seventeen the first year following banding, and one the third year after banding. Five returned for two successive seasons, two for three successive seasons. One skipped the third and returned again the fourth season after banding, and two skipped the fourth season and returned for the fifth season after banding.

It further appears from examination of his records that the cowbirds of the immediate area have a fairly wide range and are probably not daily visitors to the traps, for the records show a period of time elapsing between the normal repeat records even after making allowance for the periods that the traps are closed. Usually several days elapse between normal visits to the traps.

During the 1942 season 83 Dwarf Cowbirds were trapped and banded at the Stannard station, more than the total for the five seasons preceding. Of these, eight were recoveries from past seasons and 75 were new bandings. Of the new bandings 53 were males, 18 were females, and 4 were juveniles. The eight returns were all adults when banded.

A total of 71 individual birds were transported and liberated at points away from the banding station; a total of 144 liberations were made. Of the 71 birds moved, 43 returned at least once to the traps.

The following tabulation records the results of the liberations:

Number of Returns	*Number of Birds Moved*	*Males*	*Females*
Did not return from first	28	20	8 (2 juv.)
Returned from only one	25	20	5
Returned from two	8	5	3
Returned from three	7	6	1
Returned from four	0		
Returned from five	1	1	0
Returned from six	2	2	0

Many of the liberations were made in the Phoenix area not far from the Stannard ranch. The following tabulation lists the returns of these birds, with the airline distance accurate to within one mile; exact locations are omitted.

Number of Birds freed	*Date*	*Distance and Direction*	*Number Returning*	*Dates of Returns, 1942*
3	5/13/42	8 miles W	3	5/17; 5/26; 7/17.
1	5/14/42	8 miles SW	1	6/1.
2	5/16/42	4 miles E	2	5/24 (2).
2	5/16/42	5 miles NE	2	5/17; 5/23.
2	5/16/42	6 miles E	2	5/24; 5/28.
2	5/17/42	7 miles SE	2	5/24; 6/5.
2	5/17/42	8 miles SW	2	5/18 (2).
6	5/25/42	7 miles SW	6	5/28 (2); 6/1 (2); 6/2; 6/3.
4	5/26/42	5 miles SW	3	5/27; 5/28 (2).
6	5/30/42	5 miles SW	6	5/31; 6/1; 6/2 (2); 6/3; 7/16.
9	6/ 1/42	5 miles SW	7	6/2; 6/3 (2); 6/6 (2); 6/15; 6/17.
9	6/ 1/42	7 miles SW	8	6/2 (2); 6/3; 6/5; 6/6; 6/12; 6/15; 6/17.
5	6/ 3/42	5 miles SW	4	6/4; 6/6 (3).
13	6/ 9/42	5 miles SW	8	6/12; 6/13 (2); 6/14; 6/16; 6/26; 7/1; 7/19.
9	6/12/42	8 miles SW	2	6/14; 7/16.
6	6/21/42	5 miles SW	1	7/19.
6	7/10/42	8 miles SW	1	7/14.

In the following tabulation are the results of the liberations made at more than 10 miles from the Stannard ranch. The approximate distances are airlines obtained by measurements on an official state map. In these liberations attention was directed toward freeing the birds at a point where water was fairly close.

Number of Birds Freed	*Freed At*	*Airline Distance*	*Date Freed*	*Number of Returns*	*Dates of Return (All in 1942)*
1	Mesa	13	5/21/42	1	5/26.
1	Chandler	18	5/21/42	0	
1	Sacaton	32	5/21/42	0	
1	Coolidge	46	5/21/42	1	5/25.
1	Picacho Peak	80	5/21/42	1	5/27.
1	Tucson	110	5/21/42	0	
13	Wickenburg	54	6/ 2/42	7	6/13 (2); 6/15; 6/16; 6/17; 6/24; 7/16; 7/24.
14	Glendale	13	6/16/42	7	6/17; 6/22 (2); 6/26; 6/29; 7/17; 7/19.
7	Gila Bend	56	6/29/42	1	7/8.
16	Higley	24	7/19/42	1	7/24.
4	Superior	52	7/27/42	0	

It is impractical to list the travels of each individual cowbird that was "taken for a ride," but detailed records for four sample birds are of considerable interest.

No. 40-167022. Male, banded 5/22/41; retrapped on 5/1/42.
Liberated 4 miles east on 5/16, retrapped 5/23.
Liberated 7 miles southwest on 5/25; retrapped on 6/1.
Liberated 7 miles southwest on 6/1; retrapped on 6/4.
Liberated 8 miles southwest on 6/12, retrapped on 6/14.
Liberated in Glendale, 13 miles west, on 6/16, retrapped 6/29.
Liberated at the Capitol, 8 miles southwest on 7/10. Did not return.

No. 40-187092. Male, banded 5/15/42.
Liberated 5 miles northeast on 5/16; retrapped on 5/17.
Liberated 8 miles southwest on 5/17, retrapped on 5/18.
Liberated in Mesa, 13 miles east, on 5/21, retrapped on 5/26.
Liberated 5 miles west on 5/26, retrapped on 5/28.
Liberated 5 miles west on 6/3, retrapped on 6/6.
Liberated 7 miles southwest on 6/8, retrapped on 7/19.
Liberated at Higley Army Air Base, 24 miles east on 7/19, and did not return.

No. 40-187096. Male, banded 5/17/42.
Liberated at Picacho Peak, 80 miles southeast on 5/21, retrapped on 5/27.
Liberated 5 miles west on 5/30, retrapped on 6/2.
Liberated 5 miles southwest on 6/3, retrapped on 6/4.
Liberated 5 miles southwest on 6/9, retrapped on 6/13.
Liberated 13 miles west in Glendale on 6/16, retrapped on 6/22.
Liberated 56 miles southwest in Gila Bend on 6/29, retrapped on 7/8.
Liberated 8 miles southwest on 7/10, and did not return.

No. 40-187104. Female, banded 5/17/42.
Liberated at Coolidge, 46 miles southeast on 5/21, retrapped on 5/25.
Liberated at Wickenburg, 54 miles north northwest on 6/2, retrapped on 6/13.
Liberated at Glendale, 13 miles west on 6/16, and did not return.

Great variation is noted in the time required for birds liberated together to return to the station. Three birds liberated 8 miles west of Stannard's on May 13 returned, respectively, on May 17 and 26, and July 17. Fourteen liberated in Glendale, 13 miles west, at 8:30 P.M. on June 16, returned over a long period. One was back in the trap at 7:00 A.M. on June 17, two on June 22, one June 26, one June 29, one July 17, one July 19, and seven did not return.

On May 21 the writer was travelling from Phoenix to Nogales and left Phoenix with six cowbirds. The first, freed at Mesa (13 miles) returned to the traps on May 26; the next two (Chandler, 18 miles, and Sacaton, 32 miles) did not return to the traps. The bird released at Coolidge, 46 miles, was retrapped on May 25, and the one released at Picacho Peak, 80 miles, was recovered on May 27. One released in Tucson, 110 miles, did not return.

Thirteen birds were released at Wickenburg, 54 miles north-northwest, on June 2; seven came back to the traps, the first two on June 13, the last on July 24. Of seven freed at Gila Bend, 56 miles southwest, only one came back; and of sixteen released at Higley Army Air Field on July 19, only one made the 24 mile trip back to the Stannard traps.

It would appear from study of the records that male cowbirds must predominate greatly, or that they are easier to trap, for a great preponderance of males has been trapped.

Analysis of the detailed records shows that the transported birds returned to the trapping station, if they came at all, usually more quickly than did birds trapped and released at the station; that is, if two cowbirds were trapped, one taken away and one released at the station, the bird released some distance away was usually back in the traps more quickly than the one that was released at the traps. The logical explanation is that the transported bird arrived "home" hungry and went quickly to the traps for food.

Further study of the records indicates that a large percentage of the birds transported and liberated before June 20 returned to the trapping station, while only a small percentage of the birds liberated after that date came back to the traps. Field observations indicate that this change is correlated with the ending of the active breeding season, for by late June large flocks of cowbirds have assembled in the Phoenix district; there is little evidence of paired activity, and trapping becomes less active.

Stannard will continue the study in other seasons to such extent as circumstances may permit, and it is hoped that further information may be assembled.

SUMMARY

A study of the homing instinct of the Dwarf Cowbird, *Molothrus ater obscurus*, was made in the vicinity of Pheonix, Arizona, during the summer of 1942 by Carlos Stannard and the writer.

One hundred and forty-four liberations involving 71 individual cowbirds were made at points other than the banding station.

Sixty-six birds were liberated in the Phoenix district within 10 miles of the banding station *prior* to June 10; of these, 56 returned to the traps. Of 21 birds released in the same area *after* that date, only four returned.

Thirty-three cowbirds were released at distances ranging from 13 to 110 miles away *prior* to June 20; of these 17 returned to the traps. Of 27 liberated at distances of from 20 to 56 miles *after* June 20 only two returned.

The longest return flight was that of a male cowbird released at the foot of Picacho Peak, 80 miles from the Stannard ranch, on May 21, which returned to the traps on May 27. The greatest percentage return among a large group of liberated birds was when seven returned out of a total of 13 released at Wickenburg, 56 miles to the north-northwest; the first two came back in 12 days, the last in about seven weeks.

Owing probably to their hunger, cowbirds that had been transported and released at a distance returned to the traps more speedily than did birds banded and released *at* the traps.

Males appear to outnumber considerably females in the population.

During the last part of June cowbirds in the Phoenix district begin to flock, and there is notable cessation of activity, and in the number trapped. It seems apparent that the homing instinct displayed is closely correlated with the active breeding season even though the cowbird is parasitic and builds no nest of its own.

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HOMING EXPERIMENTS WITH HERRING GULLS AND COMMON TERNS[1]

By DONALD R. GRIFFIN

INTRODUCTION

THE homing experiments described below were undertaken to obtain quantitative data bearing on the various theories advanced to account for the sensory basis of homing in birds. Herring Gulls and Common Terns were selected because both nest in large colonies and because extensive banding has traced their migration routes. Of 176 gulls which were carried as far as 872 miles, 162 or 93% are known definitely to have returned. The terns did not home so well, and only 34 (42.5%) returned out of 80 carried 94 to 456 miles.

Both species were released in familiar territory and in areas which almost certainly offered no previously perceived landmarks. A few were recaptured after a successful return flight and were shipped again to the same release point. The results of these experiments indicate how much use the birds may make of landmarks already known to them before the artificial transportation. A comparison of homing speeds from different release points permits certain conclusions about the effects of coastlines and river systems. Eight gulls were traced over a part of their return route, by observation from the ground and from airplanes. These definitely traced return routes throw some light on the behavior of the birds while they are orienting themselves. Certain important correlations were found between the birds' ability and atmospheric conditions. In a final section these data are discussed briefly with reference to the various theories of the sensory basis of homing. These theories have been reviewed in detail elsewhere (Griffin, in press).

These homing experiments were conducted during 1939, 1940, and 1941 with Common Terns (*Sterna hirundo*) and Herring Gulls (*Larus argentatus*) at a breeding colony on Penikese Island in Buzzard's Bay, Massachusetts. On one part of this island 300 to

[1]Part of a thesis submitted to the Graduate School of Arts and Sciences of Harvard University in partial fulfillment of the requirements for the degree of Doctor of Philosophy, June, 1942.

400 pairs of Herring Gulls nest on level grassy ground which made it possible to set traps over the nests. On another area there is a large colony of Common Terns estimated to contain 7,000 to 10,000 nesting pairs, and also a much smaller number of Roseate Terns.

Professor K. S. Lashley has contributed indispensable encouragement and advice throughout the experiments. The expenses have been defrayed in part through the generosity of Mr. Henry S. Shaw, the Society of Fellows of Harvard University, and Professor Alexander Forbes. The Woods Hole Oceanographic Institute very kindly provided a boat for transportation between Penikese and the mainland during 1941, and I am also indebted to this Institute for many other facilities and conveniences. Special thanks are due Mr. J. A. Hagar and the Massachusetts Division of Fisheries and Game for helpful cooperation and advice, and for permission to work at Penikese, which is a state sanctuary.

While birds are being released, someone should always be watching at the colony for returns, and in my case this was possible only because of a sort of wholesale cooperation from many of my friends. Invaluable assistance was rendered in watching for returns or in releasing birds by Malcolm Miller, Hermann Rahn, Joseph Riley, David E. Davis, Howard Vogel, Margaret Robinson, Robert Galambos, Robert B. Holden, Darcy Gilmour, G. Edgar Folk, Francis Friedman, V. C. Wynne-Edwards, Harold B. Hitchcock, Max F. Day, N. Nash, G. Bramhall, J. Warriner, G. F. Snell, D. G. Mayer, and Mary Sears. Douglas H. Robinson and Henry M. Parker deserve special acknowledgement, for they spent long periods on Penikese watching for returns while I was ashore releasing birds or attempting to trace their return routes. I am also greatly indebted to Professor Alexander Forbes for following gulls with his airplane so that I could attempt to trace their return route, and to Terris Moore and Norris Rakestraw for flying planes in similar attempts. Lastly, Mr. F. C. Lincoln and the U. S. Fish and Wildlife Service together with the Canadian National Parks Bureau granted all possible cooperation in issuing permits for this work. In addition the Fish and Wildlife Service permitted me to examine the recovery records of banded gulls and terns.

METHODS

Trapping.—Birds were trapped over nests, in most cases with complete clutches of eggs, and only one bird of each pair was taken. For terns, I used the simple "up-wind drop trap" described by Austin (1934). For Herring Gulls two types of traps were used: a funnel type, and in 1941 a more successful spring door type (Fig. 1). Both were made of 2″ mesh hexagonal netting, and staked

to the ground over the bird's nest, or held in place by rocks. The funnel type was 2′ wide, 5′ long, and about 18″ high, with the netting bent in at the ends to form funnels tapering from the full width of the trap to an opening just wide enough to admit the gull. This opening should be at least 1′ high. Such a trap is best left for 3 or 4 days with the funnels bent open to the full width of the trap, so that the gulls can walk freely in and out. Then when the birds are to be trapped, the funnels are bent in to the "set" position, and the colony left undisturbed for about an hour. At the end of this time we would rush into the colony with as much noise as possible, and

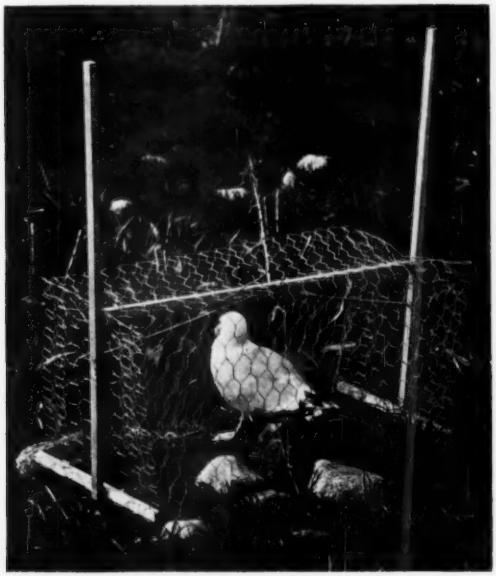

FIG. 1. Herring gull in spring door trap (note trigger rod extending across trap just above eggs).

transfer the gulls to cloth bags. It was necessary to work fast, and to keep the gulls frightened, or they would find their way out through the funnel openings.

The spring door traps (Fig. 1) were about 5′ x 2′ x 2′, with the 2′ square end openings covered by a wire netting gate, hinged at

the top, and held closed by an ordinary screen door spring. Wooden rods fastened vertically along the center lines of the gates and extending three feet above the hinges held the gates open when swung up until the rods lay along the top of the trap. A simple trigger mechanism of heavy wire held the wooden rods to the top of the trap until a gull attempted to incubate. When the gull disturbed the trigger rod (extending across the trap 4″ above the eggs) the gates closed. Additional wooden strips across the bottoms of the gates and along the center of the top were necessary to prevent the wire from bending.

Herring Gulls are not trapped easily, and the netting should be as inconspicuous as possible. Eighteen gauge wire is satisfactory for the funnel traps, and 16 gauge for the spring door type. They can be bent to fit fairly rough terrain, and by turning out a few inches of netting at the bottoms they can be weighted down with rocks. The birds will not hurt themselves against the netting if undisturbed—in fact, they usually settle on the eggs again within five minutes. But when alarmed and struggling to escape they are likely to cut their wrists and feet, or break the wing feathers if not removed within a very few minutes.

Shipping.—All birds were shipped in wooden boxes with ventilation provided through covered openings which would permit no landmarks to be seen on the trip away from Penikese. No food was given since in all but the three longest shipments the transportation time was less than 36 hours. In the worst case gulls survived 57 hours with neither food nor water, although it is of course desirable to give them an opportunity to drink No ill effects could be detected after shipment except that the birds were sometimes tired, and the outer primaries and the tail feathers were usually soiled and the barbs separated. This gave them a bedraggled appearance, but did not prevent rapid and powerful flight. In carrying gulls by airplane, cloth bags were used in some cases (shipments 4, 5, 9, and 10); but the birds were apt to become excessively hot, and a few even died from this cause. Shipments 6, 7, and 11 were made by plane in small metal boxes essentially like the regular wooden ones, but covered by wet towelling to cool them by evaporation.

Identification and Timing.—Birds were banded and also marked with quick-drying enamel paint in definite positions on both sides of the head, so that every individual had a characteristic pattern which could be recognized with binoculars or telescope. The colors used were red, green, and black on white areas, and white on the black crown of the terns. Blinds were located in central parts of the gull and tern colonies, from which could easily be seen the nests of all birds used in these experiments. The paint marks could be

read with certainty on gulls at 200–300 yards, and on terns at 75–100 yards, provided that they were standing still. Flying birds could very seldom be identified, and it would often be necessary to observe a standing one for 4 or 5 minutes until it presented a clear view of the marked areas.

Usually the eggs of gulls would be destroyed by other gulls if the transported birds did not return within two or three days. In spite of this loss of eggs or nest, the bird would return to the territory it had established around the nest, and would often stand there for long periods during several days. For this reason it was possible to check the return time of gulls with considerable accuracy and assurance that they were seen soon after they reached the island.

Terns on the other hand were never seen molesting each other's eggs, but usually the untrapped mate would incubate for only two or three days unless the transported bird returned. When a tern arrived at its nest and found that the eggs had been deserted, it usually remained only a minute or two, and often never reappeared. This necessitated constant attention throughout the daylight hours, and may well have resulted in failure to record one or two returns.

I was unable to devise a method of determining age or sex of most of the gulls used, except that all were in the adult plumage. Both sexes seem to share incubation approximately equally, however, and certainly the results show that both home well. Work of this type would be improved, however, if age and sex were known, for some of the variability in homing performance might be thus explained.

The nests were watched as nearly continuously during the daylight hours as practicable. Usually at least 8–10 hours a day were spent in the tern blind when birds might be returning. The gulls were easier to spot since they remained for much longer periods near the nests, and an average of five hours per day was spent in the gull blind. The majority of returns were secured during the early morning and in the evening; at these times many more gulls are present at a breeding colony, and the watch was kept more constantly then.

Obviously the recorded times are maximal; any bird may have returned sooner. Conversely, the percentages recorded are minimal. Except as noted below, however, I am confident that 9 out of 10 gulls were recorded within an hour or two of their first arrival. It seems unlikely that many of the gulls escaped observation entirely after actually returning to Penikese, since none of those recorded season following their return to Penikese, but none of those recorded as "d.n.r." (did not return) have been retaken in later seasons. However, one tern, No. 326, was found dead on Penikese the

season following its release at Rochester, N. Y. It had never been observed at Penikese until found in 1941 by another bander.

Observation after release.—When possible the birds were watched with binoculars or telescope after their release, but frequently they would all land on the nearest water, so that individuals in the group could no longer be recognized at a distance. Time did not permit a long wait for such birds to begin their return flight.

Ten attempts were made to follow gulls with a small airplane, because this method promised to yield very interesting data if homing gulls could be followed for any great distance. The safest and most practicable procedure was to circle about 2,000 feet above the bird. A Herring Gull is easily visible at this distance without using glasses, and the bird stands out clearly against all types of ground except white sand or a reflection of sunlight off water. Overcast days are therefore best for airplane observations.

When the plane is 2,000 feet above him, the gull gives no visible evidence of alarm or abnormal behavior. However, with a 145 h.p. Cessna monoplane at 1,000 feet, one gull became alarmed and would turn back every time that the plane flew across its path.

It is desirable to have a plane which will fly as slowly as possible, both to reduce gasoline consumption and thus increase flying time, and also to spare the observer from the somewhat unpleasant effects of prolonged flying at high speeds in small circles. The popular two place cabin planes are the best available because they can be flown at only 50 to 60 m.p.h. When flying in a straight line a Herring Gull averages about 30 miles per hour, and with these small planes one circle need be made only about every five minutes to keep the bird under observation. A "tandem" plane is preferable to a "coupe" because both pilot and observer have a good view on both sides. Autogiros would be still better, but they are scarce and expensive and usually have an insufficient fuel capacity for long flights.

Even my limited experience demonstrated both the difficulties and promise of airplane observation. More flexible planes with better visibility and longer flying time are needed for best results, but much can be done with the light planes obtainable at present. Days with high solid clouds are best, unless the aircraft can fly as slowly as the bird and thus avoid the necessity of circling and passing through a part of the circle where glare from water will render the bird invisible. Mufflers would no doubt permit a closer approach without frightening the bird. There is an indefinable feeling in watching a bird from the air that one is in the bird's own medium and can understand its problems and behavior far better than would ever be possible from the ground.

EXPERIMENTAL RESULTS

For all the transported terns, the time from release to first subsequent observation at Penikese Island is shown in Table 1.[1] Similar data for the Herring Gulls is presented in Fig. 2. Each gull's speed of return is shown graphically in the right hand portion of Fig. 2 by a solid dot.

In Fig. 2 I have attempted to summarize the weather conditions occurring while the birds of each experimental group were returning to Penikese. The complete data would consist of several hundred detailed weather maps, so that an extreme form of condensation has been necessary. Under the headings "Winds," "Convection," "Visibility," and "General" are entered symbols summarizing the weather for the entire period during which the birds in question were returning. The symbols range from + + + (Highly Favorable) to − − − (Very Unfavorable). Winds are considered favorable when strong and blowing from release point towards home. Convection is entered as favorable when cumulus clouds and unstable lapse rates[2] indicate the presence of updrafts. Cool temperatures, unlimited visibility, and fair weather are also considered favorable conditions. Gulls may be quite sensitive to heat as shown by the death of three which became too hot during transportation. Prevalent cloud types are listed in the last column, using the conventional abbreviations. The shipments are arranged in Fig. 2 according to approximate distance of shipment, and within distance groups according to average speed of return. This arrangement brings out any correlation between weather conditions and speed of return.

TABLE 1. HOMING OF COMMON TERNS

(d.n.r.=did not return. m.=miles. hrs. i.c.=hours in captivity.)
In computing average speeds, Nos. 79, 138, and 199 are neglected since they seemed weak or injured when released.

Shipment No.	*Place and time of release*	*Bird No.*	*Total time*	*Speed (miles per day)*
35	New Haven, Conn.	961	7 hrs.	350 (14.6 m.p.h.)
	102 m. West	963	10 hrs.	244 (10.2 m.p.h.)
	June 19, 1941	965	20 hrs.	122 (5.1 m.p.h.)
	9:45 a.m.	964	21 hrs.	117 (5.1 m.p.h.)
	22 hrs. i.c.	962	79 hrs.	31

[1]The shipments and individual birds are numbered for reference. The left-hand column contains the place and date of release (Eastern Standard Time), the distance and direction from Penikese to the release point, and the number of hours in captivity (abbreviated "*hrs. i.c.*"). The times given are total, including darkness. They are in hours up to 96 hours, and in days and hours for longer intervals, as they seem easiest to visualize in this form. A day is, of course, always 24 hours, beginning at the actual time of release. Speed of return is total time divided by the shortest distance (great circle) between home and release point, expressed in miles per day. In cases where the total time was less than 24 hours, the time is given in miles per hour as well. The tables would be misleading otherwise; for a bird such as No. 961, while flying 102 miles in 7 hours, traveled at the rate of 350 miles per day, whereas it might very well have been unable to maintain the same speed for 24 hours.

[2]Lapse rate is the rate of decrease of air temperature with altitude.

36	Gardner, Mass.	960	10 hrs.	228 (9.5 m.p.h.)	
	95 m. N.W.	959	11 hrs.	207 (8.6 m.p.h.)	
	June 19, 1941	957	21 hrs.	109 (4.5 m.p.h.)	
	8:40 a.m.	956	80 hrs.	28	
	22 hrs. i.c.	958	d.n.r.	—	
37	Newburyport, Mass.	952	24 hrs.	94	
	94 m. North	954	26 hrs.	87	
	June 19, 1941	951	32 hrs.	71	
	9:17 a.m.	955	32 hrs.	71	
	23 hrs. i.c.	953	d.n.r.	—	
38	Atlantic City, N. J.	937	42 hrs.	134	
	234 m. S.W.	936	55 hrs.	102	
	June 17, 1941	940	67 hrs.	84	
	12 noon	938	d.n.r.	—	
	27 hrs. i.c.	939	d.n.r.	—	
39	Burlington, Vt. (Lake	942	40 hrs.	145	
	Champlain, near S. Hero)	941	d.n.r.	—	
	242 m. N.W. x N.	943	d.n.r.	—	
	June 17, 1941	944	d.n.r.	—	
	5:00 p.m.	950	d.n.r.	—	
	30 hrs. i.c.				
40	Belfast, Maine				
	(Penobscot Bay, near	945	65 hrs.	84	
	Bucksport)	946	65 hrs.	84	
	228 m. N.E.	949	16 d., 7 hrs.	14?	(Identifica-
	June 17, 1941	947	d.n.r.	—	tion
	12:50 p.m.	948	d.n.r.	—	uncertain)
	26 hrs. i.c.				
		306	37 hrs.	262	
		302	51 hrs.	190	
41	Cape Charles, Va.	408	51 hrs.	190	
	404 m. S.W.	304	51 hrs.	190	
	June 20, 1940	305	63 hrs.	154	
	4:38 p.m.	409	7 d., 21 hrs.	51?	(Identifica-
	29–31 hrs. i.c.	413	d.n.r.	—	tion
		301	d.n.r.	—	uncertain)
		303	d.n.r.	—	
		327	38 hrs.	243	
42	Rochester, N. Y.	324	4 d., 20 hrs.	79	
	384 m. W. x N.	322	5 d., 0 hrs.	77	
	June 21, 1940	326	13 months	1	(found dead)
	3:00–4:00 p.m.	also eight birds	d.n.r.	—	
	50–54 hrs. i.c.				
43	Eastport, Maine	314	49 hrs.	153?	(identifica-
	312 m. N.E.	312	5 d., 0 hrs.	62	tion
	June 21, 1940	313	6 d., 2 hrs.	51	uncertain)
	3:15 p.m.	also six birds	d.n.r.	—	
	50–54 hrs. i.c.				

44	Shediac Bay, N. B. (Gulf of St. Lawrence) 456 m. N.E. June 10, 1941 12:05 p.m. 28–30 hrs. i.c.	five birds	none returned	—
45	Shediac Bay, N. B. June 29, 1941 2:20 p.m. 30 hrs. i.c.	410 also four birds	87 hrs. d.n.r.	126 —
46	College Bridge, N. B. (Upper Bay of Fundy, near Sackville) 445 m. N.E. June 10, 1941 2:20 p.m. 30 hrs. i.c.	932 933 931 934 935	45 hrs. 77 hrs. d.n.r. d.n.r. d.n.r.	238 138 — — —
47	Sackville, N. B. 445 m. N.E. June 29, 1941 3:40 p.m. 31 hrs. i.c.	412 also four birds	77 hrs. d.n.r.	139 —

In Table 5 are presented data on certain special homing experiments with Herring Gulls which are discussed below under "Miscellaneous Observations."

The location of the various release points is shown in Figs. 3 and 4. Some are omitted from Fig. 4 to prevent crowding, and these are listed in Tables 1 and 5 and Fig. 2 as "near" some release point shown on the map.

The percentage of returns of Herring Gulls (93% of 176 shipped 15 to 872 miles) was exceptionally high compared with the results of homing experiments with other birds. Goethe (1937) also reported almost 100% returns with European Herring Gulls. Terns were not nearly as good homers, approaching 100% only at 100 mile releases. Of 80 shipped 94 to 456 miles, 42.5% returned.

There are great variations in the homing speed of different gulls from the same point on the same day, and striking differences in the average speed of return of groups released at the same point on different days. Terns were not tested as thoroughly as gulls, but they too showed great variability in homing speed. Pigeon fanciers find similar differences in homing speed on different days, and Rüppell (1935) has noted cases of the same sort with starlings.

Weather Conditions

The relationship between bird flight and atmospheric conditions is an interesting study in itself, and it has an important bearing on

the homing problem. For the ornithological aspects of this subject the reader is referred to Woodcock (1940a; 1940b) and Aymar (1935). Excellent discussions of the meteorological background can be found in Petterssen (1940) and Barringer (1938).

It is obvious that severe storms or very strong adverse winds would slow the homing of gulls and terns, regardless of the sensory basis of their orientation. Such storms were encountered after the release of groups 12, 15, 26, 27, 33, 44 and 46. As might be expected these groups showed a longer homing time than others sent to the same release point.

Less violent weather conditions also have a great effect on the flight of Herring Gulls as Woodcock (1940) has recently shown so clearly. Gulls prefer soaring to flapping flight and they are reluctant to travel long distances in air which is devoid of rising currents. Woodcock has shown, for instance, that Herring Gulls fly far out to sea from the New England coast only in winter when convection currents result from the meeting of cold air and warmer water. In my homing experiments the gulls tended to take off more readily after release and to cover more ground on days when rising currents of air were available.

Gulls have been observed to soar by means of thermal updrafts (caused by heating of air near the ground); obstruction updrafts (produced when a horizontal wind is deflected upwards by hills or buildings); and finally by means of velocity gradients in a horizontal wind produced in the first few hundred feet of air by friction at the surface (dynamic soaring). The first class is probably the most useful, for under favorable conditions thermal updrafts may be very powerful and widespread. An example of the power developed is the common heat thunderstorm, usually occurring in the afternoon of a hot day, when part of this convection energy is released as lightning. This source of power enables both soaring birds and glider pilots to make long journeys "riding the updrafts."

Atmospheric conditions adapted to one of the three types of soaring are the rule rather than the exception, for any wind will produce some updrafts. The worst condition is one with little wind, warm air and clouds which prevent solar heating of the ground. Stable air, which cools slowly as one ascends, is also unlikely to contain thermal updrafts and is thus bad for soaring.

A study of Fig. 2 shows that many of the differences in the homing times of gulls can be accounted for by weather conditions. The most rapid returns of gulls all occurred when there were strong winds blowing in the general direction of home with strong convection (groups 3, 6, 14, 16, 24, and 29). Hot stable air seemed to make gulls reluctant to take off after release, and when generally

stable conditions prevailed gulls had to flap the entire distance or wait for better weather. Such stable air was prevalent after the release of groups 10, 20, and 28.

Some of the conclusions to be drawn from Table 3 in the section on "returns from familiar and unfamiliar territory" must be modified by consideration of weather. The Chicago-Savannah comparison, for instance, is not as critical as it appears, since the latter group had much more favorable winds and convection, although subject to greater heat. Gulls of group 25 did poorly despite good weather, but they were either kept abnormally long in captivity or else were weak and in poor condition. Some but not all of the differences in first and second returns from the same release point could be due to weather, as stated below in the section dealing with these second shipments.

On the other hand, Table 2 (terns) is not greatly affected by weather considerations. The birds at each distance were released at approximately the same time, and the weather was generally good for all nine groups. If anything, the inland and northeast coastal groups were favored, so that the differences shown in the table clearly cannot be ascribed to the weather. Terns are not soaring birds and they are probably far less dependent on updrafts than the gulls. Furthermore, the comparisons between groups 44 and 45 vs. 46 and 47; 26 vs. 27; and 20 and 21 vs. 17, 18, 19, and 22 remain significant because the differences in homing time are not those to be expected from the weather situation.

It is clear that data on homing and migration speeds, at least of soaring birds, cannot be safely compared unless the atmospheric conditions are taken into account.

Returns from Familiar and Unfamiliar Territory

Two hundred records of Common Terns banded in Massachusetts and recovered outside the state were obtained from the U. S. Fish and Wildlife Service. 191, or 95.5%, were from points southwest along the Atlantic coast, from the West Indies, or from South and Central America. Five, or 2.5%, were from northeast along the coast, in Maine or the Maritime Provinces; and only four, or 2%, were inland on the Great Lakes or in Quebec. Similar figures for 526 Herring Gull recoveries (birds banded in Maine and Massachusetts) were 94.6% southwest along the coast; 3.8% northeast coastal; and 1.6% inland in the Mississippi Valley or the Great Lakes. Gross (1940) reports that of 773 recoveries of banded Herring Gulls from Kent's Island, N. B. only nine, or 1.2%, were from inland points (Great Lakes, upper New York State, or the upper St. Lawrence Valley).

Thus it seems likely that release points more than 100 miles northeast along the coast were probably outside the territory familiar to the terns, and points 100–400 miles inland almost certainly so, while any area southwest along the coast had undoubtedly been visited on previous migratory flights. Herring Gulls are frequently seen along inland waterways, and, in contrast to the terns, those released 100–250 miles inland may not have been very far from familiar territory. The occasional inland excursions of gulls may be of short duration, so that practically no

FIG. 3. Release points of gulls and terns.

banded ones are recovered; yet they may be sufficient to acquaint the birds with considerable inland geography. However, points over 500 miles inland, such as Port Stanley and Chicago, were almost certainly in unfamiliar territory, while of course all the

southwest coastal regions must have been visited on previous migrations.

The per cent returns and the average homing speed (miles per day) from these three classes of release point are summarized in Tables 2 and 3. The speeds are averages of those birds which did return.

TABLE 2. HOMING OF COMMON TERNS FROM FAMILIAR AND UNFAMILIAR TERRITORY

Distance shipped	*Southwest coastal (known)*	*Northeast coastal (probably unknown)*	*Inland (unknown)*
94–102 miles	100% 171 m./d.	80% 81 m./d.	80% 144 m./d.
228–242 miles	60% 107 m./d.	40% 84 m./d.	20% 145 m./d.
312–404 miles	56% 199 m./d.	22% 57 m./d.	25% 133 m./d.

TABLE 3. HOMING OF HERRING GULLS FROM VARIOUS DIRECTIONS

Distance shipped	*Southwest coastal (known)*	*Northeast coastal (probably unknown)*	*Inland (probably unknown)*
94–104 miles	100% 68 m./d.	100% 210 m./d.	96% 143 m./d.
234–302 miles	100% 84 m./d.	100% 118 m./d.	92% 83 m./d.
445–540 miles	—	87% 52 m./d.	60% 57 m./d.
870–872 miles	80% 120 m./d.	—	67% 58 m./d.

There is a marked tendency for terns to home faster and in higher percentages from what the banding evidence suggests are familiar regions. These differences were not due to weather conditions, for the weather was generally good in all cases, the wind direction favoring the inland and southwest coastal groups at 100 miles, but favoring the birds from unknown territory in the longer shipments.

The gulls, on the other hand, show a much less clear trend for better returns from familiar territory (Table 3). Some of those shipped 100–250 miles may have made use of experience gained on previous inland flights. Or variability caused by weather conditions or other factors may mask any trend which might appear in a sufficiently large series of homing experiments. The birds released at Port Stanley had been in captivity 57 hours owing to delays at customs and express agencies, and their relatively poor showing may be from this cause rather than because they were in

unfamiliar territory. The gulls shipped to Chicago and Savannah show the most striking contrast; in fact, the Savannah group returned faster than those released only about half the distance northeast along a coast which was perhaps unfamiliar. (Compare shipments 29 and 26.) But this comparison is not as conclusive as it seems, for the Chicago and New Brunswick birds had definitely adverse weather conditions, while almost every aspect of the winds and weather were ideal for those released at Savannah. As shown above many of the other differences in homing of these gulls can be similarly explained.

Thus the data from shipments of terns fit quite well the theory of exploration by radial scattering from the release point (Claparède, 1903). The per cent returning falls off sharply once the birds are carried far into unknown territory, even though it be along the coast where food and a suitable environment are available. The generally low percentages of returns recorded may be partly due to the technical difficulties discussed on page 7; but the relative difference between familiar and unfamiliar territory can scarcely be due to a failure to observe the birds at their nests. Yet on the other hand, there is little decrease in the speed of those birds which do return. With gulls there is only a slight trend towards better homing from familiar territory, and what difference there is might well be due to a familiarity with local atmospheric conditions or food resources, rather than because their orientation depends upon recognition of familiar landmarks. The same reasoning can less easily be applied to the terns, for in their case the differences in homing performance are more striking. To be sure, their feeding habits are so specialized that knowledge of local conditions may assume greater importance than with gulls, but the difference in homing performance from southwest and northeast coastal points seems too striking to explain on this basis.

SECOND SHIPMENTS OF THE SAME BIRD

During 1940 and 1941 we captured several gulls which had already been shipped to a distance once during the previous season and had returned within a few days. Nine of these were carried again to the same release point, or another not far distant. Four others were released at quite different points. The results are summarized in Table 4.[1]

[1] I have not included in Table 4 one gull shipped twice to Lake Champlain whose homing time was 26 hours the first year and 71 hours the second year because it was very weak and in bad condition when released on the second occasion. Nor have I included two additional birds (Nos. 159 and 161) shipped 8 and 14 days respectively after their first shipment, in both cases to Penobscot Bay. These two returned at exactly the same time from their first shipment, their nests being 50 feet apart. No. 161 was shipped again 8 days after its first trip, along with 162, which was back promptly in 26 hours. But No. 161 was very slow, and when it did come back it was again at exactly the same time as 159 returned from a second shipment. Evidently the two had met somewhere along the way. After they were back No. 159 on at least one occasion was clearly seen feeding the young of 161 which had hatched in their absence. Clearly some unusual social relationship was involved, and homing may well have been delayed by other factors than sensory difficulties.

TABLE 4. HERRING GULLS TRANSPORTED TWICE TO THE SAME RELEASE POINT

Bird No.	*Release point*	*Interval between shipments*	*First release*		*Second release*	
			Homing time	*Speed (miles per day)*	*Homing time*	*Speed (miles per day)*
95	Lake Champlain	1 year	10 days	29	29 hours	199
100	Lake Champlain	1 year	4½ days	52	48 hours	120
110	Lake Champlain	1 year	6 days	40	18 hours	120
150	Newburyport, Mass.	24 days	9 hours	250	30 hours	118
151	Newburyport, Mass.	15 days	10 hours	225	8 hours	282
162	Penobscot Bay, Me.	8 days	29 hours	200	26 hours	216

The three cases where birds were shipped about 250 miles in two different years seem to be very interesting (Nos. 95, 100, and 110). All were quite slow on their first trip and a year later they showed a very marked improvement. This is just what one would expect if they had deviated considerably from the true course in exploring for familiar landmarks, but profited by the experience when shipped to the same region the following season. These three cases are of course too few to rely upon.

The weather may have had some effect, for Nos. 95 and 110 had better conditions for the second trip, but No. 100 did not, and the improvement of 95 and 110 was much greater than the usual difference between birds released in good as opposed to mediocre weather. Nos. 150, 151, 159, 161, and 162 all had better weather for their second trip than that encountered after the first release. Nos. 150, 151, and 162 showed no important difference between first and second shipments, but the interval between shipments was so short that the homing performance may have been impaired for this reason.

Of the four birds shipped the second time to a different release point some were slower and some faster on the second shipment. Apparently this correlated with the weather conditions, and the details do not seem worth reproducing. The lack of any clear trend indicates that a second trip *per se* did not have any effect.

EFFECTS OF TOPOGRAPHY AND GEOGRAPHY

Shipments 26, 27, 44, 45, 46, and 47 were designed to test the birds' tendency to follow a coastline. Gulls and terns were released on both sides of the isthmus connecting Nova Scotia to New Brunswick. The total distance differed by only 4%, yet in one case the birds were in the Bay of Fundy, one coast line of which

would lead them home directly, while in the other case they were released in the Gulf of St. Lawrence, where one coastline would never lead them home while the other would do so only with a detour of several hundred miles.

The results showed a definite difference in homing performance. With terns both speed and per cent returns were less from the Gulf of St. Lawrence. Three out of ten returned from the Bay of Fundy, while only one out of ten came back from the Gulf of St. Lawrence. With gulls the homing varied in the same way. In neither case was the difference as large as one would expect if the coastlines were followed blindly. The first two gulls to return from the Gulf of St. Lawrence probably flew directly across the isthmus, for their homing time is approximately that of the first birds back from the Bay of Fundy. But others were so slow that they could have flown around Nova Scotia, while perhaps the slower birds of the Bay of Fundy group flew down the Nova Scotia side of the bay and then turned back. This suggests the possibility that birds released along an unfamiliar stretch of coast might remain near it, flying in either direction for some time and turning back if they found nothing familiar. About half should take the right direction if they did this, while the others might be able to realize their mistake after flying two or three hundred miles and still be able to return in time to constitute the slower returns from actual coastal release points.

A comparison of the birds released at Lancaster, Charlotte, South Hero, Mt. Johnson, and Montreal is also interesting. (Shipments 17, 18, 19, 20, 21, and 22). All were released along watercourses, but on very different ones which would vary widely in their usefulness as guide-lines for an exploring bird. At Lancaster the only river is the Connecticut which dwindles to a very small size within 50 miles to the north, but flows straight south to Long Island Sound with which the gulls were probably familiar. Lake Champlain is drained by the Richelieu River, flowing north; but Lake George and the Hudson valley might look equally attractive to a lost gull. Montreal, however, is on a large river which would have led the gulls far astray if followed in either direction. The returns show a slight deterioration in homing performance as we go from Lancaster and Lake Champlain on the one hand to Mt. Johnson and Montreal on the other. The Mt. Johnson results might be explained by the weather, but the Montreal release was on the same day with the same conditions as the Lancaster and the first South Hero shipments.

BEHAVIOR AFTER RELEASE

There is only one way to establish with certainty whether birds in unknown territory fly straight home rather than by exploring

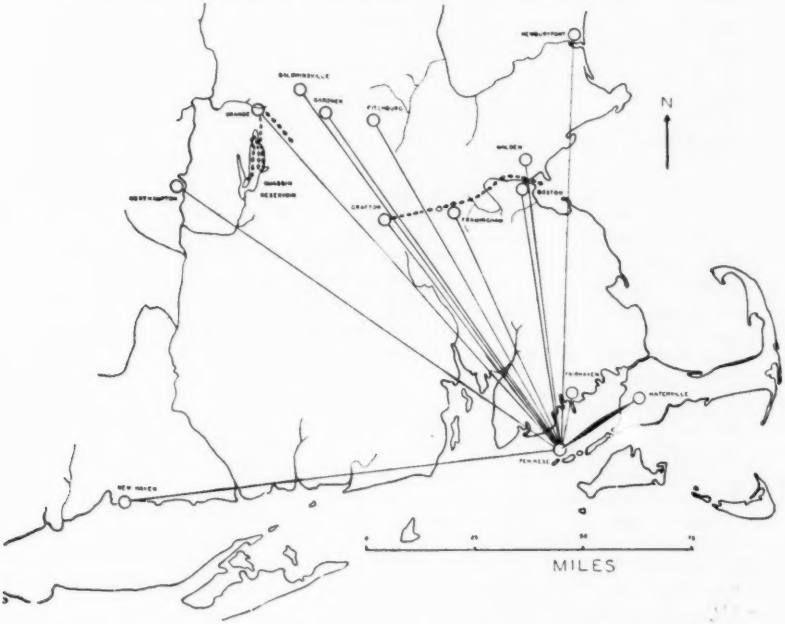

FIG. 4. Release points of gulls and terns, together with actual return routes of three gulls traced by direct observation from airplanes (cases 4, 5, and 6).

at random. The return route must be observed directly, either by recoveries en route or by following the birds. As described above, it is easy to observe the initial direction taken by a bird immediately after its release. But unless special methods are used it is seldom possible to trace them for more than about a mile. Twenty-five Herring Gulls were thus observed near the point of release. As with some other species (Rüppell 1935), there was no marked tendency to start home in the correct direction.

To analyse the results of these observations further, I have computed the coefficient of correlation between the speed of the

bird's return and the deviation of its initial course from the true course home. If the birds tended consistently to continue their initial course for long distances, those returning first should be the ones showing the least deviation from the true direction of home, and the correlation between deviation and speed should be high and negative. Actually the coefficient of correlation for 25 gulls between deviation (compass points) and speed of return (miles per day) was +0.772, and the coefficient between deviation and order of return was −0.286. This indicates that if anything the birds which started in the wrong direction were the first to return.

However, the direction of the first mile or two of flight may be determined by local topography, a search for food or water, or merely a desire to depart as rapidly as possible from the observer. There is almost always much circling and changing of direction at this time, although there was no indication of any one definite pattern of behavior on release, some birds flying off immediately in a straight line, others circling and still others landing on the ground or water at the first opportunity and remaining there for long periods. Of course, birds in poor condition would often be slow to take off, and on hot overcast days when the air was very stable and had little "lift" the gulls were noticeably reluctant to fly at all. This is merely a special case of the dependence of gulls on updrafts which has been noted by Woodcock (1940).

By methods described above it was possible to observe a few Herring Gulls for longer distances, in one case for 37.5 miles of the return flight. Most of the gulls discussed below are included in the 25 whose initial direction was found not be to correlated with speed of return. Except for Case 3, the birds may not have been far from familiar territory. This is particularly important in considering Cases 4, 5, and 6.

Case 1.—At Charlotte, Vt., on May 16, 1940, nine gulls were released on an overcast day with low clouds and occasional rain showers. The wind was southeast and fresh to strong. The birds were followed with a 50-power telescope from the top of a 900 foot hill (Mt. Philo) which rises steeply from the surrounding plain about two miles west of the release point. Eight birds landed on Lake Champlain about a mile east of the point where they were set free. One, however, started directly southeast—almost exactly in the direction of its home. Yet this bird made the poorest homing record of the group. No sign of it was seen until 39 days after its release when a bird with worn paint marks was observed which might have been the one in question. The paint was too badly worn, however, to permit certain identification, so that it is questionable whether this gull returned at all.

Case 2.—Ten birds were released May 26, 1940, at the foot of a 750 foot hill (Mt. Johnson) near the Richelieu River, about half way from Lake Champlain to the St. Lawrence. The wind was southeast and moderate. The birds' home lay 291 miles to the southeast. The birds were watched from the hilltop with binoculars and telescope and the behavior of those which could be traced for any distance was as follows:

No. 41—Circled constantly but drifted gradually north and was lost about five miles due north of the release point. This bird returned in 79 hours, the fastest of the group.

No. 43—Flew north with much circling and was lost seven miles north of the release point; homing time 91 hours, the third bird to return.

No. 44—Circled near release point, found an updraft and rose within a few minutes to 4,000 or 5,000 feet. Return time, 7 days, 21 hours, the eighth bird to return.

The remaining Mt. Johnson birds either rested on the ground until the observers left or were lost before they had flown more than a mile. None flew south while under observation.

Case 3.—One of the five gulls of group 25 released May 31, 1940, at Port Stanley, Ontario, was observed by Mr. and Mrs. J. M. Spiers at Toronto, Ontario, from June 9 to June 12. This bird returned to Penikese on the 16th, and at Toronto it was not very far off the true course home. Evidently the final 460 miles from Toronto to Penikese were accomplished in four days, whereas the gull may have used nine days to cover 115 miles from Port Stanley to Toronto.

Case 4.—On June 28, 1940, gull No. 140 was released at 3:55 p.m. from an airport near Grafton, Massachusetts—67 miles N.W. of Penikese. It was followed by Dr. Norris Rakestraw of the Woods Hole Oceanographic Institute in a Piper "Cub" tandem plane with Dr. Mary Sears as observer. The wind was W.S.W. less than 10 m.p.h. on the ground. The gull was unable to soar, but flew off with a steady flapping flight, N.W. for five minutes, south, then east, southeast with occasional circling, and then east for twenty minutes. During this period there was much changing of direction, but the bird's next course was easterly. At 4:30 p.m., it landed for seven minutes on a reservoir near Ashland, Mass., then rose and headed east again for about seven minutes when it evidently found a weak updraft. For at this point it rose to about 1,000 feet although it had previously never exceeded 200–300 feet. At all times, however, the flight was flapping and not soaring. When it had risen to about 1,000 feet, Boston was clearly visible from the plane and apparently the gull could see it also, for after this point there was very little deviation from a straight easterly course. The bird was followed all the way to Boston harbor, but was unfortunately lost there. At 6:15 p.m. of the following day this gull returned to Penikese, although there had been strong S.W. winds, rain, and generally nasty weather most of the day. This gull's course, as far as it was traced, is shown in Fig. 4.

Case 5.—On May 23, 1941, seven gulls were released at Orange, Mass., and observed from a 90 h.p. Rearwin airplane with Dr. Norris Rakestraw again flying and the writer observing. In the early morning it was clear and calm, but gradually a N.N.W. wind sprang up and cumulus clouds began to form at about 4,000 feet. At 9:45 a.m. when the first bird was released the ground wind was 15–25 m.p.h. and gusty. Cumulus clouds had by then covered about half the sky; and by 11:00 there was an almost solid overcast; at 11:45 there was one brief shower. The temperature was about 60° and there were strong updrafts. The wind velocity increased throughout the day and by 2:00 p.m. it was at least 50 m.p.h. at 2,000 feet. The visibility, excellent at the beginning of the observations, became steadily poorer, and at 2:00 p.m. was 5 miles to the west and 8–9 miles in other directions.

Five of the birds were lost before they had flown more than a mile; their initial directions were included in the correlation calculations on page 20. The strong thermal updrafts enabled all birds to soar well and they wheeled in circles with very little flapping, often gaining altitude rapidly without much effort.

No. 403, released at 10:30 a.m., flew strongly and with considerable circling S.S.E. to a pond about two miles from the airport where it had been released. It

sat on a stump in the middle of the pond splashing and preening from 10:40 to 11:20 when it flew off, soaring and circling to the S.E. (downwind). At Petersham (about twelve miles from the release point) it evidently found an updraft of unusual intensity, for it circled steadily over one area and rose until our plane was forced to within 500 feet of the solid cloud base. The plane was not equipped with blind-flying instruments and could not safely (or legally) climb much farther. The gull continued to rise until it could no longer be observed because the wing of a high wing monoplane greatly restricts visibility at one's own altitude when the plane is circling.

When last seen this bird was 10 to 12 miles from the airport, at least 2,500 feet above the ground, and climbing rapidly so that it must soon have approached the clouds.

At 12:50 p.m., No. 171 was followed as it circled to the southeast from the airport, rising with little flapping, and when 2 or 3 miles from the airport it began the same rapid climb in a strong thermal updraft. At 1:05, it was lost at about 2,500 feet after the same frantic chase in steep climbing turns.

As shown in Fig. 2, this group of gulls (shipment No. 3) returned with remarkable speed. The weather conditions were ideal, and if the birds had merely drifted downwind while soaring the N.W. wind would have brought them to the coast quite near to Penikese. Since the wind was certainly 40 to 50 m.p.h. at altitudes to which two gulls were observed to climb, these returns may not represent any better orientation than that displayed by other groups.

Case 6.—On July 18, 1941, another successful attempt was made to follow gulls released at the Orange airport with the writer flying an 85 h.p. Rearwin two place tandem airplane and George Scott observing. The weather was ideal for the purpose, temperature about 70° or 75° F., wind gentle S. to S.W. and a high broken overcast at more than 5,000 feet. The visibility was about ten miles. No. 367, released at 10:00 a.m., alighted on a sandy patch and was lost, but when No. 369 was released, at 10:10, it flew to the south and was soon joined by the first bird. These gulls flew mostly by flapping, with an occasional short period of gliding flight; there were apparently no updrafts capable of supporting prolonged soaring.

These two gulls remained within a few hundred feet of each other and flew to the south with some circling. They turned S.W. as they approached Quabbin reservoir, a large artificial lake (as yet only partially filled) lying about five miles south of the airport. At 11:25, both gulls landed on a wooded island in this lake and then moved to the middle of one of its arms a few minutes later. After five or ten minutes more, one of them flew north almost to the end of the lake and then back to where they had separated. The other had disappeared by this time, and the one just back from the north end of the reservoir began to explore its southern branches. At 11:55 it was over the S.W. section of the lake heading S.W. or W. as though preparing to fly over the land. The Connecticut River lay about 15 miles to the west, but it would not have been visible to the gull, for even at 2,600 feet we could not see it and the gull was within 300 feet of the lake.

At this time we lost sight of the gull because an army training plane appeared and flew for some minutes so close to us that we had to cease circling and following the gull to avoid collision. When this exasperating disturbance ended we searched the entire vicinity but failed to find either gull again.

Fig. 4 shows the relative positions of Penikese, Grafton, and Orange and the routes followed by these birds while they were under observation. These maps of return routes are tantalizing in their inadequacy; but they show how much will be learned when more such work is done. The method of airplane observation

is quite practicable under the right conditions; and it offers the best method to test critically the exploration hypothesis. Unfortunately it is slow and expensive; but after the present war light planes and helicopters should be developed further and the method can then no doubt be extended.

Despite their inadequacy, a few tentative generalizations can be made from the data presented above. Evidently a gull released inland tends to search for strong updrafts and to climb on them if possible to at least 3,000 feet (Cases 3, 4, and 5). This will give greater visibility if the air is clear, or if the bird is going to drift with the wind, it would be carried much faster at higher altitudes. If updrafts are available the birds may drift downwind while riding on them (Cases 2 and 5). They frequently fly to a large body of water and rest there to preen and drink or feed (Cases 1, 4, 5, and 6). The direction of flight up to three miles from the release point is in no way related to the true direction of home. Of seven birds followed for more than three miles only two (Case 2) took a completely wrong direction. Those followed farthest (Cases 3, 4, 5, and 6) were making relatively small deviations from a true course home (45°, 75°, 0°, and 45° respectively). But it should be recalled that in Cases 4, 5, and 6 the birds may have found familiar landmarks. Many more observations like those presented above will be needed to give a final answer to the question raised by Hodge (1894) and Claparède (1903): Do birds fly straight home or do they explore at random?

Miscellaneous Observations

On May 26, 1940, four gulls were carried to South Hero, Vt., and kept in constant rotation from New Bedford, Mass., to Keene, N. H., when the mechanical rotating device (mounted on a trailer) ceased functioning. The birds (group 34) showed no ill effects of the treatment, and behaved normally on release, as shown in Table 2. They were distinctly slower (67, 60, 52, and 36 miles per

Table 2. Miscellaneous Homing Experiments with Herring Gulls
(Same abbreviations as Table 1)

Shipment No.	*Place and time of release*	*Bird No.*	*Total time*	*Speed (miles per day)*
30	Fairhaven, Mass.	129	6 hrs.	60 (2.5 m.p.h.)
	15 m. N.N.E.	133	22 hrs.	16 (0.7 m.p.h.)
	June 7, 1940	131	25 hrs.	14
	10:20 a.m.	132	5 d., 3 hrs.	3
	4 hrs. i.c.	130	6 d., 8 hrs.	2
31	Hatchville, Mass.			
	22 m. N.E.	154	17 hrs.	31 (1.3 m.p.h.)
	May 17, 1941	156	17 hrs.	31 (1.3 m.p.h.)
	3:30 p.m.	155	26 hrs.	20
	7 hrs. i.c.			
32	Woods Hole, Mass.	197	9 hrs.	40 (1.7 m.p.h.)
	15 m. E.N.E.	200	78 hrs.	5
	June 8, 1941	198	4 d., 6 hrs.	4
	9:45 a.m.	301	4 d., 6 hrs.	4
	25 hrs. i.c.	199	8 d., 2 hrs.	2 (weak)

Group No.	Place of release	Date & time of release	Number of birds	Distance shipped (miles)	Direction shipped	Winds	Convection	Visibility	General weather	Cl ty
3	Orange	May 24, 1941 - 10 a.m. - 2 p.m.	7	104	N.W.	+++	++	+	+	
14	Newburyport	May 15, 1941 8 p.m.	4	94	N.	+++	++	+	+	
6	Orange	July 12, 1941 10 a.m.	2	104	N.W.	++	++	+	+	Cu
5	Orange	July 5, 1941	1	104	N.W.	−−	++	+	±	Cu
2	Northampton	June 15, 1940	4	106	N.W. x W.	+	+	±	±	
8	Baldwinsville	May 21, 1939	10	101	N.W. x N.	+	−−	−−	±	Ac
11	Framingham	July 11, 1941	1	62	N.N.W.	−−	±	−	+	Ca
1	New Haven	May 21, 1939	9	100	W.	−	−−	−−	−	Ac
10	Grafton	June 28, 1940	1	67	N.W.	−−	±	−−	±	Ac, Ba
13	Malden	June 5, 1940	4	67	N.	+	++	+	+	Cu
7	Orange	July 18, 1941	2	104	N.W.	−−	±	±	±	Cu
12	Boston	May 22, 1940	2	63	N. x W.	++	−−−	−−	−−−	N Ist
16	Atlantic City	June 17, 1941 12 noon	5	234	S.W.	++	+++	+	+	C
24	Bucksport	May 22, 1941 5 a.m.	5	241	N.N.E.	++	+	+	+	Cl
23	Bucksport	May 15, 1941 5 a.m.	4	241	N.N.E.	−−	±	±	±	cle
19	South Hero	June 2, 1940 5 p.m.	12	247	N.W. x N.	++	+	−	±	Aa (h
17	Charlotte (Lake Champlain, 20m. S. of S. Hero)	May 16, 1940 2 p.m.	9	230	N.W. x N.	+	+	−	−	Aa, (ra
22	Lancaster	June 1, 1939 9 a.m.	10	214	N. x W.	++	++	+	+	Ac
21	Montreal	June 1, 1939 7 p.m.	8	302	N.N.W.	+	+	+	+	Ac
18	South Hero	June 1, 1939 3 p.m.	10	247	N.W. x N.	+	+	+	+	Ac
20	Mt. Johnson (near Montreal)	May 26, 1940 1 p.m.	10	291	N.N.W.	−	−	±	±	mi
15	Atlantic City	June 3, 1941 3 p.m.	5	234	S.W.	−−	−−	−	−−−	N Ist
29	Savannah	June 4, 1941 3 p.m.	5	870	S.W.	++	++	+	+	Cu
26	College Bridge (near Sackville)	June 10, 1941 2 p.m.	7	445	N.E.	±	+	+	+	mi
28	Chicago	May 31, 1941 4 p.m.	6	872	W.	−	−−	−	−	S
25	Port Stanley	May 31, 1940 4 p.m.	5	540	W. x N.	+	±	+	+	mi
27	Shediac Hay	June 10, 1941 12 noon	8	456	N.E.	±	+	+	+	mi

Fig. 2 - HOMING EXPERIMENTS W

...ti-ty	General weather	Cloud types	Per cent returns	Av. Speed (miles per day)
+	+	Cu	100%	281
+	+	Cu	100%	210
+	+	Cu & Cb	100%	191
+	±	Cu & Ac	100%	119
±	±	Cu	100%	96
--	-	Ac & St	100%	87
-	+	Cu & St	100%	74
--	-	Ac & St	100%	68
--	±	Ac, St & mist	100%	62
+	+	Cu & St	100%	49
±	±	Cu & Cl	50%	45
--	---	Ns (storm)	100%	9
+	+	Cu	100%	114
+	+	Cb	100%	107
±	±	clear	100%	100
-	±	As & St (hot)	100%	97
-	-	As, St, Ns (rainy)	89%	93
+	+	Ac	100%	90
+	+	Ac	75%	84
+	+	Ac	100%	80
±	±	mixed	90%	53
-	---	Ns (storm)	100%	49
+	+	Cu	80%	120
+	+	mixed	100%	59
-	-	St	67%	58
+	+	mixed	60%	57
+	+	mixed	75%	44

Speed of return of individual birds (miles per day)

50 100 150 200 250 300 350 400 450

(716)

(Bdnr)

(Bdnr)

(Bdnr)

EXPERIMNTS WITH HERRING GULLS.

33	Orange, Mass.			
	104 m. N.W.	194	32 hrs.	78
	(anaesthetized en route)	193	44 hrs.	57
	June 5, 1941	195	4 d., 8 hrs.	24
	11 a.m.	192	14 d., 9 hrs.	7
	24 hrs. i.c.			
34	South Hero, Vt.			
	(Lake Champlain)	50	88 hrs.	67
	247 m. N.W. x N.	99	4 d., 2 hrs.	60
	(rotated during transportation)	100	4 d., 19 hrs.	52
	May 26, 1940	102	6 d., 21 hrs.	36
	4.00 p.m.			
	34 hrs. i.c.			

day) than others released at South Hero (shipments 18 and 19), but little if any slower than those released the same day at Mt. Johnson (shipment 20) about 40 miles to the north. In view of the distinct possibility that gulls home by exploration, no further attempts at rotation experiments were made, nor did I test the effects of rotation *per se*. The slight difference between the rotated birds and group 20 does not seem sufficient to offer any serious support to the kinesthetic theory.

One preliminary experiment with transportation under anaesthesia was also attempted (group 33—see Table 2). Abbott veterinary Nembutal (1 gram per ml.) was given in two equal intramuscular doses into each pectoral muscle. A total initial dose of 0.6 to 1.0 ml. was sufficient to anaesthetize two gulls completely so that all postural reflexes were lost, although the nictitating membrane responded when the cornea was touched. The birds had to be well wrapped, otherwise they became chilled (first symptom was cold feet, followed by violent shivering and death). To keep the birds unconscious extra doses of 0.5 ml. were necessary at 45 min. to 2 hour intervals. There was great individual variation, one bird dying after 1.2 ml., while others were still active after greater doses. To keep four birds unconscious during a five hour auto trip from Barnstable, Mass., to Orange required 1.5, 2.0, 2.1, and 2.7 ml. respectively.

Two of the birds (Nos. 193 and 195) recovered well and flew actively after less than an hour's rest. The others, Nos. 192 and 194, were noticeably weak when liberated. Unfortunately there was a steady rain and stormy winds on the day of release, so that the rather poor homing which resulted may have been due to this cause. The only comparable weather occurred after shipment No. 12 when even slower homing resulted. The details of this shipment under anaesthesia are given for the possible benefit of future workers; obviously the results themselves are of no significance.

One fact which I am totally unable to explain is the poor homing

of birds released very close to home (see Table 2—shipments 30, 31, and 32). I can only point to similar phenomena noted in homing experiments with other birds (Loos, 1907; Goethe, 1937; Watson and Lashley, 1915; and Griffin, 1940a). Even bats home better when released at 10–50 miles than when set free very close to their homes (Griffin, 1940b). If this is a consistent effect it might conceivably offer a clue to the fundamental problems of homing.

With bats I have offered the explanation that the annoyance of trapping and handling was, in local releases, associated with the home, and thus homing was discouraged, while at greater distances such was not the case. A purely local release of four Herring Gulls resulted in the return within 3 or 4 hours of all four birds, so that this explanation does not seem as satisfactory as with bats.

DISCUSSION

Like most preliminary data, these homing experiments seem to raise more questions than they solve. No really valid comparisons of homing times from various release points are possible without several releases at each point on as many days. Only in this way could one obtain statistically significant results in which the effects of weather conditions and other variables could be neglected. So far I have not been able to operate with Herring Gulls on a sufficiently large scale to secure such data; and conclusions based on a single release at a given point are very dangerous regardless of the number of individuals involved.

It is clear that the gulls scattered in all directions for the first mile or two, and if they are able to select the correct direction without visual landmarks, the process of orientation requires considerable time. Very few gulls or terns came home at average speeds even approximating their known velocity of flight. The majority may have either deviated considerably from the true course home, as in exploring for known visual landmarks, or else they may have spent long periods resting or searching for food. Three gulls showed a marked improvement in homing speed when shipped a second time to the same release point, while with terns at least there was a clear drop in percentage (but not in speed) of returns as the distance of shipment was increased. These facts are consistent with the hypothesis that the birds may scatter in any direction from the release point and return only when they encounter by chance some part of the area with which they are already familiar. Evidence concerning the actual route followed is necessary to actually test such theories.

In addition to the records listed above under "Behavior after release" Rüppell (1937) records three cases in which starlings were

recovered *en route* with deviations from the true course of 9°, 9°, and 20° and Gibault (1930) reports six cases in which untrained pigeons visited other lofts en route home from unknown territory, none registering more than about 60° deviation. These records indicate that an essentially straight course is followed, but there are some exceptions (Case 2 above) and more observations of the return route are needed before one can draw satisfactory conclusions. The use of airplanes and helicopters for the study of bird behavior is a practically untouched field, and it seems to offer great promise of solving not only this problem but many others as well.

SUMMARY

1. 176 herring gulls were released at distances from 15 to 872 miles from their nests on the coast of Massachusetts. 163 or 93% returned the same season that they were transported. Of 80 common terns carried 94 to 456 miles, 34 or 42.5% were definitely observed at their nests within the next few days.

2. The speed of return of herring gulls varied from 15 miles in 8 days to 104 miles in 3¼ hours. At distances of 60 to 300 miles practically all birds returned, most of them covering from 50 to 200 miles per day. At greater distances there were almost always some losses, but at 872 miles inland 4 out of 6 returned. In most cases the average speed of return was far below the gulls' known velocity of flight (25–30 m.p.h.), so that if they flew at all continuously they must have deviated extensively from the direct course home.

3. Those terns which did come back to Penikese averaged from 31 to 350 miles per day—most of them covering more than 100 miles per day.

4. Much of the variability in the gulls' homing seems to be correlated with weather conditions. Rapid homing is favored by unstable air with strong updrafts to permit soaring, moderate to fresh favorable winds, good visibility, and lack of violent winds or prolonged precipitation.

5. Returns from territory which the banding evidence indicates to be familiar to the birds were faster and losses fewer. This tendency was clearly marked with terns, but with gulls it was so confused by weather-induced variability that its existence can be questioned.

6. Three gulls homed very slowly in 1940 but when shipped to the same release points in 1941 they returned with remarkable speed. This could have been caused only in part by the weather conditions, and may well have been due to the learning of visual landmarks during the first return flight.

7. A slight deterioration in homing could be noted when birds were released on river systems or parts of the coastline where the

topography might tend to lead them astray; but the data are insufficient to constitute more than a suggestive tendency.

8. Twenty-five Herring Gulls were observed for the first two to 37 miles of their return routes, and they showed no correlation between the correctness of their initial direction and speed of return.

9. Two birds were observed to fly 5 and 7 miles in a direction directly opposite to that of their home. Five others were followed for 5 to 37 miles with an airplane and one was observed en route at 115 miles from the release point. When last seen these birds had deviated about 45°, 75°, 0°, 0°, 45°, and 45° from the true course home. The two showing no deviation were drifting downwind.

10. Homing was very slow when the birds were carred only 15–25 miles—a fact which is difficult to explain in view of the striking returns from much longer shipments.

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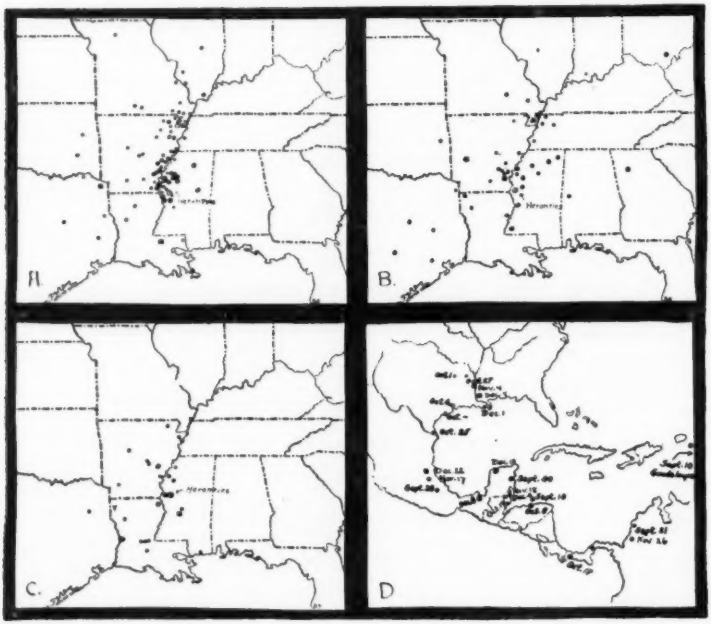
POST-JUVENAL MIGRATION OF HERONS

By BEN B. COFFEY, JR.

THIS paper lists recoveries, from nestlings banded in central Mississippi in late May and early June, during the subsequent period of July to December. Species include American Egret, Little Blue Heron, Snowy Egret and Yellow-crowned Night Heron; also the Water Turkey, or Anhinga, which nests in similar habitats.

My results are necessarily from juvenal birds, but adult birds also take part in a northward movement which occurs in late summer and early autumn. This "reverse migration" has always been of interest to me, long before my personal involvement in bird banding provided data on individual birds. In analyzing the



Explanation to Maps of Heron Recoveries:
A. July; B. August; C. September; D. October and points outside United States.

● American Egret
★ Snowy Egret
■ Anhinga
○ Little Blue Heron
Y Yellow crowned Night Heron
⊙ Site of Heronries

recoveries reported during this time of year, I decided to group them chronologically and plot on respective maps. Thus it is possible to note the dispersal of these birds, month by month, until October when most of them have left the country.

Several heronries were visited. Recoveries from nestlings of the same general region near Greenville, Mississippi are shown on the maps; a separation by heronries is not pertinent. Those from Moon Lake (Coahoma County), Miss. are not shown on the maps since the heronry is about 125 miles north of the Greenville group; however, these recoveries are tabulated to complete the record. I am indebted to: Mr. Claude Beeson of Holly Bluff for transportation and other assistance in connection with the heronry on his property there; to William Turcotte of Clinton, Mississippi for information on the Good Hope colony; to Prof. R. L. Caylor of Delta State College, Cleveland, for information and guidance into the Glen Allan heronry, and to Mr. George Uzzelle, present owner, for permission to band there; to Mr. B. F. McCamey, Jr., discoverer, and Mrs. Turner Morehead, owner, of the location at Moon Lake.

Final publication of this article was undertaken after my entrance into the armed forces; I am grateful to Mrs. Coffey for her assistance at this time.

	Totals Banded				
Greenville, Miss. Area	*American Egret*	*Little Blue Heron*	*Snowy Egret*	*Anhinga*	*Totals*
1935					
June 1, Holly Bluff.....	133				133
June 2, Good Hope.....	32	100			132
June 15, Holly Bluff.....	32			58	90
June 16, Good Hope.....	74	283	10	35	402
Totals 1935.....	271	383	10	93	757
1936					
May 24, Glen Allan.....	438	465	19	102	1,024
May 31, Good Hope.....	28	408	10		446
June 7, Glen Allan.....	28	137	23	150	338
June 8, Glen Allan.....	73	158	8		239
Totals 1936.....	567	1,168	60	252	2,047
1937					
May 23, Glen Allan.....	861	992	13		1,866
June 6, Glen Allan.....	774	841	201	66	1,882
Totals 1937.....	1,635	1,833	214	66	3,748
1941					
May 25, Glen Allan.....	656	2		75	733
June 8, Glen Allan.....	360	22	40	69	491
Totals 1941.....	1,016	24	40	144	1,224
*Totals, Greenville Area..	3,489	3,408	324	555	7,776

*Also banded June 6, 1937, Glen Allan, Yellow-crowned Night Heron, 44; and 1935, Good Hope, Black-crowned Night Heron, 10.

Moon Lake, Miss.	*Little Blue Heron*	*Snowy Egret*	*Totals*
June 3, 1940	640	60	700
June 1, 1941	472	54	526
June 7, 1942	745	129	874
Totals	1,857	243	2,100

TABLES OF RECOVERIES

I. AMERICAN EGRETS

A. 1937 BANDINGS, GLEN ALLAN, MISS.

BANDED MAY 23, 1937		*Date*	BANDED JUNE 6, 1937	
Band No.	*Place of Recovery*	*Recovered*	*Band No.*	*Place of Recovery*
37-711092	Greenville, Miss.	6/25		
36-720374	Warren, Ark.	6/28		
		6	37-719141	Chester, Ill.
37-711174	Greenville, Miss.	7/ 2		
37-711028	Greenville, Miss.	7/12		
37-711260	Greenville, Miss.	7/12		
36-715302	Cleveland, Miss.	7/12		
36-720164	Kennett, Mo.	7/14		
37-711054	Proctor, Ark.	7/14		
37-711333	Calamine, Ark.	7/14		
37-711449	Dora, Mo.	7/15		
37-711134	Pollard, Ark.	7/16		
36-720436	Holcomb, Mo.	7/18		
36-720417	Kennett, Mo.	7/19	37-719200	Greenbrier, Mo.
		7/20	37-711739	Qulin, Mo.
		7/21	37-719713	Trenton, Miss.
		7/21	37-719517	Leland, Miss.
		7/21	37-719615	Winterville, Miss.
		7/21	37-719289	Halley, Ark.
36-715317	Pocahontas, Ark.	7/23		
36-720097	West Memphis, Ark.	7/23		
		7/24	37-711630	Moscow, Texas
37-711078	Cary, Miss.	7/24	37-711928	Yazoo County, Miss.
37-711447	Glen Allan, Miss.	7/25		
36-720216	Summerfield, Ill.	7/25		
36-720295	Marianna, Ark.	7/26	37-719056	Sweet Home, Ark.
37-711141	Winterville, Miss.	7/26	37-711561	Sayre, Ark.
37-711228	Chatfield, Ark.	7/27	37-711966	Harrison, Ark.
		7/27	37-719750	McAlester, Okla.
		7/28	37-711478	Malden, Mo.
37-711248	Shelbyville, Ill.	7/28	37-711484	Washington Co., Miss.
		7/28	37-711717	Caruthersville, Mo.
37-711157	Danby, Mo.	7/29		
36-720488	Butler County, Mo.	7/30	37-711887	Chicota, Tex.
37-711058	Natchitoches, La.	7/30	37-719318	Parkdale, Ark.
37-711221	Bradford, Ark.	7/31	37-719119	Lundell, Ark.
		8/ 1	37-711473	Coffeeville, Miss.
37-711269	Witt, Ill.	8/ 3		
36-715390	Marianna, Ark.	8/ 4		
		8/ 5	37-711578	Plain Dealing, La.
		8/ 6	37-719505	Rector, Mo.
36-720481	DeWitt, Ark.	8/ 8		
36-715366	Miston, Tenn.	8/11		
37-711030	Reelfoot Lake, Tenn.	8/12		
37-711093	Pocahontas, Ark.	8/14		
37-711415	Varner, Ark.	8/21		
		8/26	37-719370	Ferriday, La.
37-711255	Atlanta, Tex.	8/27		
		9/ 1	37-711851	Mound Bayou, Miss.
		9/ 2	37-719171	Atkins, Ark.
		9/ 6	37-711672	Roseland, Ark.
36-720438	Opelousas, La.	9/ 8		
37-711246	Ruleville, Miss.	9/10		
		9/12	37-711626	Moon Lake (Lula), Miss.

37-711336	Bassett, Ark.	9		
37-711098	Benzal, Ark.	9/16		
36-720166	Gulfport, Miss.	9/18		
36-720119	Keo, Ark.	9/19		
36-720404	Bunkie, La.	9/20	37-719216	Ben Wheeler, Texas
		9/21	37-719331	Cartagena, Colombia, S. A.
		10/ 1	37-711729	McCurtain County, Okla.
36-720451	Tamash River, Barranco, British Honduras	10/18		
36-720293	Monteria, Bolivar, Colombia	11/26		
		12/20	37-719354	Lafitte, La.

B. ALL BANDINGS EXCEPT 1937

Band No.	*Date Banded*	*Date and Location of Recovery*	
36-719137	May 24, 1936	July 2, 1936	Morrilton, Ark.
36-719121	May 24, 1936	July 5, 1936	Tunica, Miss.
36-719016	May 24, 1936	July 5, 1936	Ft. Jackson, La.
34-658408	June 1, 1935	July 6, 1935	Lexington, Miss. (19 mi. S.)
37-720419	May 25, 1941	July 11, 1941	Scott, Ark.
36-719534	June 8, 1936	July 12, 1936	Sibley, Miss.
36-719680	May 24, 1936	July 15, 1936	Bolton, Miss.
36-719723	June 8, 1936	July 15, 1936	Paragould, Ark.
36-719338	May 24, 1936	July 16, 1936	Muskogee, Okla.
34-658419	June 1, 1935	July 17, 1935	Bogalusa, La.
36-719330	May 24, 1936	July 19, 1936	Tenaha, Texas
36-719174	May 24, 1936	July 20, 1936	Greenville, Miss.
36-719223	May 24, 1936	July 20, 1936	Burlison, Tenn.
37-719467	May 25, 1941	July 22, 1941	West Plains, Mo.
36-719764	June 8, 1936	July 23, 1936	Oneida, Ark.
36-719547	June 8, 1936	July 24, 1936	Otto, Texas
36-720020	June 8, 1936	July 29, 1936	Ruston, La.
36-719033	May 24, 1936	July 30, 1936	Lake Jackson, Miss.
36-719551	June 7, 1936	July 31, 1936	Jonesboro, Ark.
36-719268	May 24, 1936	Aug. 3, 1936	Tamaha, Okla.
36-719435	May 24, 1936	Aug. 4, 1936	Dumas, Ark.
36-719252	May 24, 1936	Aug. 5, 1936	Normangee, Texas
36-719217	May 24, 1936	Aug. 6, 1936	Greenbrier, Mo.
37-719493	May 25, 1941	Aug., 1941	Lucy, Tenn.
37-711659	May 25, 1941	Aug., 1941	Myrtlewood, Ala.
37-720705	May 25, 1941	Aug. 10, 1941	Ringgold, La.
36-720015	June 8, 1936	Aug. 11, 1936	Hubbard, Texas
37-711674	May 25, 1941	Aug. 12, 1941	Banks, Ark.
36-719170	May 24, 1936	Aug. 14, 1936	Trezevant, Tenn.
36-719246	May 24, 1936	Aug. 15, 1936	Rock, Ill.
36-719368	May 24, 1936	Aug. 15, 1936	Gould, Ark.
37-720460	May 25, 1941	Aug. 19, 1941	Brookshire, Texas
34-661973	May 24, 1936	Aug. 20, 1936	Carlisle, Ark.
36-719791	June 8, 1936	Aug. 30, 1936	Lamont, Miss.
34-661878	June 16, 1935	Sept. 2, 1935	Evergreen, La.
37-719676	May 25, 1941	Sept. 5, 1941	Ridgeland, Miss.
34-658583	June 2, 1935	Sept. 6, 1935	Biggers, Ark.
37-719942	May 25, 1941	Sept., 1941	Hope, Ark.
37-719562	May 25, 1941	Sept. 10, 1941	England, Ark.
34-661861	June 16, 1935	Sept. 14, 1935	Cottonport, La.
37-719823	May 25, 1941	Sept. 18, 1941	Armistead, La.
34-658404	June 1, 1935	Oct. 4, 1935	Humble, Texas
34-658469	June 1, 1935	Oct., 1935	Collegeport, Texas
36-719060	May 24, 1936	Oct. 25, 1936	Alamo, Texas
36-719155	May 24, 1936	Oct. 27, 1936	Grady, Ark. (6 mi. N.)
36-719748	June 8, 1936	Nov. 4, 1936	Epps, La. (7 mi. W.)
34-658472	June 1, 1935	Nov. 17, 1935	Santana Rodriquez, Vera Cruz
37-711651	May 22, 1938	Nov. 18, 1938	Belize, British Honduras
34-661945	June 16, 1935	Nov. 25, 1935	San Antonio, Texas
34-661891	June 16, 1935	Dec. 1, 1935	Sibun River, 25 mi. from Belize, British Honduras
34-661914	June 16, 1935	Dec. 12, 1935	Terrebonne Parish, La.

II. LITTLE BLUE HERON

A. 1937 BANDINGS, GLEN ALLAN, MISS.

BANDED MAY 23, 1937		Date	BANDED JUNE 6, 1937	
Band No.	*Place of Recovery*	*Recovered*	*Band No.*	*Place of Recovery*
		7/ 2	37-631149	Ruleville, Miss.
		7/ 6	37-644199	Drew, Miss.
37-630452	Leland, Miss.	7/ 7		
37-630256	Marked Tree, Ark.	7/ 8		
37-630136	Indian Bay, Ark.	7/12		
		7/20	37-631457	Harrisburg, Ark.
36-657482	Holland, Mo.	7/22		
		7/27	37-631467	Lake Village, Ark.
37-630635	Crockett's Bluff, Ark.	7/28		
37-630489	Alligator, Miss.	7/31		
36-657639	Vicksburg, Miss.	8/ 3		
36-657700	Pollard, Ark.	8/ 5		
		8/ 7	37-630988	Batesville, Miss.
37-630595	Acworth, Ga.	8/18		
36-657463	Rosedale, Miss.	8/20		
36-657687	New Albany, Miss.	8/25		
		9/ 7	37-631034	Burr Ferry, La.
37-630729	Bonacca, Bay Islands, Honduras	9/10	37-631048	Crockett's Bluff, Ark.
37-630956	Ciudad Carillo, Quintana Roo	9/30		
		9/24	37-644042	Carroll Parish, La.
		10/ 8	37-630862	Sico, Puerto Castillo, Honduras
		10/17	37-644201	David, Chiriqui, Panama

B. ALL BANDINGS EXCEPT 1937 AND MOON LAKE

Band No.	*Date Banded*	*Date and Location of Recovery*
36-657231	May 31, 1936	July 3, 1936 Merigold, Miss.
36-657337	May 31, 1936	July 3, 1936 Denmark, Miss.
36-656311	May 24, 1936	July 4, 1936 Watson, Ark.
36-656044	May 24, 1936	July 6, 1936 Helena, Ark.
36-657411	May 31, 1936	July 6, 1936 Drew, Miss.
36-657066	May 31, 1936	July 11, 1936 Desha County, Ark.
36-657207	May 31, 1936	July 12, 1936 Jennie, Ark.
36-656445	May 24, 1936	July 20, 1936 Yancopin, Ark.
36-656534	June 7, 1936	July 20, 1936 Tallula, Miss.
36-656354	June 7, 1936	July 21, 1936 Mayersville, Miss.
36-656411	May 24, 1936	July 24, 1936 Delaplaine, Ark.
36-657241	May 31, 1936	July 27, 1936 Louisville, Miss. (17 mi. NE.)
36-656565	June 7, 1936	Aug. 1, 1936 Indianola, Miss.
35-540299	June 8, 1936	Aug. 11, 1936 Watson, Ark.
36-656359	June 7, 1936	Aug. 11, 1936 Booneville, Miss.
36-657426	May 31, 1936	Aug. 20, 1936 Isola, Miss.
36-656017	May 24, 1936	Aug. 28, 1936 Austin, Tex. (20 mi. S.)
36-656465	May 24, 1936	Aug. 31, 1936 Wellston, Ohio
36-656105	May 24, 1936	Sept. 10, 1936 St. Francois, Guadeloupe, French West Indies
36-656093	May 24, 1936	Sept. 28, 1936 Laguna de Chapulco, Puebla

C. MOON LAKE (COAHOMA COUNTY), MISS. BANDINGS (NOT MAPPED)

37-644378	June 1, 1941	June 30, 1941	Lucy, Tenn.
37-644912	June 3, 1940	July 10, 1940	Gunnison, Miss.
37-644718	June 3, 1940	July 21, 1940	Elaine, Ark.
37-645338	June 1, 1941	July 22, 1941	New Albany, Miss.
38-675072	June 1, 1941	July 22, 1941	Clarksdale, Miss.
37-644526	June 1, 1941	July 25, 1941	Hogansville, Ga.
37-645360	June 1, 1941	Sept. 10, 1941	Calhoun, Ala.
37-645042	June 3, 1940	Oct. 15, 1940	Marks, Miss.
37-644651	June 3, 1940	Dec. 6, 1940	Sittee River, British Honduras
37-645094	June 3, 1940	Dec. 13, 1940	Maxcanu, Yucatan
38-675684	June 7, 1942	July 6, 1942	Paragould, Ark.
38-675869	June 7, 1942	July, 1942	West Helena, Ark.
38-675204	June 7, 1942	July 12, 1942	Atoka, Tenn.
37-645189	June 3, 1940	Aug. 9, 1940	Crowville, La.
37-645299	June 3, 1940	Aug. 26, 1940	Abbeville, La.

III. SNOWY EGRET

Band No.	*Date Banded*		*Date and Location of Recovery*
37-630871	June 6, 1937	Aug. 5, 1937	Deering, Mo.
36-656068	May 24, 1936	Aug. 15, 1936	Sims, Ark.
37-630875	June 6, 1937	Aug. 20, 1937	Pt. Pleasant, Mo.

IV. YELLOW-CROWNED NIGHT HERON

Band No.	*Date Banded*		*Date and Location of Recovery*
37-711463	June 6, 1937	Sept. 10, 1937	near Shreveport, La.

V. WATER TURKEY OR ANHINGA

Band No.	*Date Banded*		*Date and Location of Recovery*
36-719391	May 24, 1936	July 10, 1936	New Boston, Texas
36-719445	June 7, 1936	July 20, 1936	St. Francisville, La. (6 mi. E.)
34-661803	June 15, 1935	July 28, 1935	Sharkey County, Miss.
36-719194	May 24, 1936	Aug. 7, 1936	Tillar, Ark.
37-719720	June 6, 1937	Sept. 1, 1937	Chatham, Miss.
37-719151	June 6, 1937	Sept. 20, 1937	Jackson, Miss. (East of)
36-719585	June 7, 1936	Dec. 4, 1936	Tallula, Miss.
34-661814	June 15, 1935	Dec. 8, 1935	Palizadas, Campeche
37-711582	June 6, 1937	Dec. 22, 1937	Villa Azueta, Vera Cruz

672 N. Belvedere, Memphis, Tenn.

THE NESTING OF BLUEBIRDS BANDED AS NESTLINGS

By AMELIA R. LASKEY

NEST boxes for Eastern Bluebirds (*Sialia sialis sialis*) have been placed in Percy Warner Park and the adjoining Edwin Warner Park to increase the numbers of this species around Nashville, Tennessee. Starting in 1936 with 26 boxes, others have been gradually added so that 63 have been available for the past three years. A careful analysis of the nesting data, accumulated through regular visits to the boxes, indicates that only 1,569 eggs of the 3,512 laid have been successful to the point of survival of the young to the age of 16–17 days when they normally fly from the nest. This is 44.67 per cent of the total number laid and corresponds to percentages for birds building open nests. It is markedly lower than for hole nesting species. Mrs. Nice (1937 p. 143–144) gives 40–46 per cent success for open nests and 59 per cent for hole nesting species in the north temperate zone. In Warner Parks predators are chiefly responsible for the loss of eggs, young, and brooding females. Cats and snakes regularly climb to the boxes; there has been some depredation by boys.

All nestlings are banded on the left tarsus and adults on the right. During the nesting seasons of 1937–1942, I have trapped on the nest 42 females that had been banded as nestlings in the parks in the years 1936–1941. Many mated males have been identified by

sight as park nestlings by bands on the left tarsus. But they could not be caught to read band numbers because during the six years under consideration, no male was ever found on the nest. My first record occurred in 1942 when, on July 23, I found one—without a band—brooding 3 nestlings about three days old. If as many males as females returned for nesting, a total of 84 banded as nestlings could have bred in the park, 6.5 per cent of the 1,308 fledged in 1936–1941.

Three others, one known to have been a male, were recovered within three miles of their birthplace. None have been reported as migrants.

TABLE 1. DATES OF FIRST EGGS IN FIVE SEASONS
Earliest Egg Each Year and Average Dates of First Eggs of Known Adults and First Year Birds, Banded as Nestlings.

Year	*Earliest Egg of Season*	*Adults*		*First Year*	
		Average Date of First Eggs	*Number of Birds*	*Average Date of First Eggs*	*Number of Birds*
1938	March 2[1]	March 15	2	March 26	2
1942	March 8	March 20	5	March 27	6
1941	March 14	March 26	11	April 2	4
1939	March 18	March 25	8	April 3	1
1940	April 2	April 5	3	April 11	9
Average for 5 years	March 15	March 18	29	March 27	22

There is considerable variation from year to year in start of egg laying. In 1938, a set of four was being incubated March 5; in 1939, first eggs were laid March 18 in two nests; in 1940, the first egg April 2; in 1941, March 14; and in 1942, subsequent observations indicated the first egg had been laid March 8 (a set of five was being incubated March 14). There is a relationship between temperature and start of egg laying but further study is necessary to clarify this point.

From 27 to 56 per cent of the breeding females were captured on the nest each year, a total of 42 per cent for the five year period. Records of 23 of the young females found nesting in the park showed egg laying began at ages varying from 243 to 370 days, the average being 312 days of age. Dates for their earliest egg of each season during 1938–1942 extended from March 17 (in 1938) to April 16 (in 1940) with March 27 as the average early date for the five year period.

[1]Latest possible date. A set was being incubated March 5, 1938.

The records of 27 females known to be at least two years old show the average date of first eggs during the same five year period to be March 18. This is nine days earlier than the young group. First clutches for both groups averaged five per set.

Mrs. Nice found her Song Sparrows (*Melospiza melodia beata*) in Ohio, laying at 316–372 days of age with a slight tendency to lay a little later than old birds. Eight young females averaged 4 eggs per set while 16 females two or more years of age averaged 4.5 eggs in first sets (1937 p. 106).

Kuerzi, in Connecticut, reports 6 female and 5 male Tree Swallow (*Iridoprocne bicolor*) nestlings of 1938 returning to breed in 1939—10.4 per cent of the 106 banded in the nest that year (1941 p. 41). He found that Tree Swallows laid at 344–354 days of age, averaging, like my Bluebirds, nine days later than older birds with size of sets apparently the same. He states that mature females were more efficient in nest building than one year old birds (1941 p. 25–26). His Tree Swallows were single-brooded so that range in ages is not nearly so great as in species like Bluebirds and Song Sparrows that may raise three successful broods in a season. The young Tree Swallows showed only ten days variation in ages, the Song Sparrows 57 days, and the Bluebirds 127 days. Among Bluebirds in the northern states, this wide range in ages probably would not occur because in his studies in Illinois, Musselman finds only two nesting periods. Bluebirds are summer residents there and permanent residents in Tennessee.

Kluijver, in Holland, found young Starlings (*Sturnus vulgaris L.*) laying later than the older birds and with smaller sets; their first eggs averaged 4.9±.3 while the older birds averaged 5.9±0.09 per set.

Among my Bluebirds, those hatched late in a season, during the third nesting period, began to lay at approximately the same time as those hatched in the first period. Two females, N 11, hatched August 1, and N 12, hatched August 12, 1939, laid their first eggs April 10 and April 11, 1940, respectively, while N 4 hatched April 9, 1939, laid April 13, 1940 and N 5, hatched April 16, 1939, laid April 8, 1940. Among the eight individuals of the 1939 hatch whose ages are known, there was a difference of 125 days between the oldest and the youngest, yet the youngest laid two days ahead of the oldest. Likewise this occurred in 1942 when an April bird, 86 days older than a July bird of 1941, laid her white eggs eleven days later than the younger.

Sister birds, N 15 and N 16, hatched July 20, 1940, laid their first eggs one week apart, March 30 and April 6, 1941.

In 1942 a mother bird and her 254 day old daughter each had four eggs in neighboring boxes on March 30. The older bird laid

an additional egg the following day.

Three individuals had their first nests in the same boxes in which they had been hatched. Two of them, N 11 and N 13, laid white eggs. Four others used boxes in meadows adjoining their birthplaces. Boxes are 500 or more feet apart, separated by narrow thickets.

One female hatched in 1938 from a 7 egg set (100 per cent successful) was found incubating the following year in a box not far from her birthplace. Her sets consisted of 5 eggs.

A number of individuals have laid white eggs but there has been no evidence as yet to show this to be an inherited trait in this group. No. 36-146599 hatched April 1937 from an albino egg was found in 1939 laying blue eggs. No. 38-121000 banded as an adult on April 6, 1939 was then incubating 6 white eggs. In 1940 one of those hatched from this set, N 6, laid five blue eggs in the adjoining meadow. The following year N 6 had moved on to the next meadow, laying 6 blue eggs in the second nesting period. From this hatch, N 22 was found in 1942 as she incubated 6 blue eggs. Thus daughter and granddaughter of the white-egg-laying female were laying nomally colored eggs.

Five birds known to have been hatched from blue eggs laid white eggs: N 1, N 11, N 13, N 18, N 21. Only N 11 was found in two seasons. In April 1940 at 253 days of age she began her first set of 5 in the box where she had been hatched from a set of 4 blue eggs. For the season she laid 5-5-5-4 white eggs with only the third successful. She deserted the first two sets soon after completion and the young of the fourth set when they were five days old. She reappeared in the box in March 1941, laying 5 albino eggs, one blue-tinged. Four young were raised; one egg was sterile. May 6 she began her second set of 5 white eggs but disappeared at the time this set was hatching.

In 1942 there were more white eggs laid than in any previous season. They consisted of 3 sets of 4, 8 sets of 5, 2 sets of 6, and 1 set of 7. This total of 71 white eggs was 9.1 per cent of the 774 laid this season. There seemed to be 6 or 7 females laying them. Two, N 18 and N 21, were nestlings of 1941; three were found unbanded, including the one with the 7 egg set, indicating they were not raised in the Warner Parks boxes. Incidentally it might be mentioned that sets of 7 Bluebird eggs are rare; the 1938 and the 1942 sets are the only records in the Nashville area.

In addition to the nestlings in the park boxes, a considerable number are banded as I find them elsewhere, many from tin cylinders on posts on roadsides placed there by suburban and country residents for their newspapers. A female, hatched in one of these tin receptacles in early June 1941, was found April 16,

1942 incubating 4 eggs in a Warner Parks' box about five miles from her birthplace. At the home of one of my neighbors, a female hatched in April 1937 was nesting in the same garden two years later in a box 125 feet from the one in which she had been hatched.

So far, none of my banded nestlings have been found after three years. The high rate of mortality through predation is doubtless the main factor in this prevailing short life span. The oldest Bluebird of record in the Parks' group is an adult female banded May 1939 and nesting there each year. Her latest recapture was in April 1942, when she was at least 4 years old. Another female banded at my home as an adult April 1936 was retrapped each year until Nov. 4, 1939 when she was at least in her 5th year of age.

Grateful acknowledgment is made to Mrs. Nice for suggestions and for references she kindly furnished from her files.

SUMMARY

From 3,512 Bluebird eggs laid during seven years in two adjoining parks, 1,569 young were fledged—44.67 per cent. Forty-two females banded as nestlings have returned to nest in the parks; also one banded elsewhere nested in the park, five miles from her birthplace. Numerous mated males banded as nestlings are seen at the nests.

The first eggs of 23 birds were laid at ages of 243–370 days, average, 312. Egg laying started on the average date of March 27 (1938–1942), nine days later than a group of 27 birds two or more years old. Size of sets did not differ with age, five being the average.

Late and early hatched birds laid at approximately the same time the following spring.

Laying of white eggs is apparently not an inherited trait; a daughter and a granddaughter of a white-egg-laying female laid blue eggs. Five females hatched from blue eggs laid white eggs.

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Graybar Lane, Nashville, Tenn.

GENERAL NOTES

On Deciphering Worn Bands.—For the convenience of bibliographically minded bird-banders I would like to call attention to Hoyes Lloyd's note on this subject in the Canadian Field Naturalist (1939, Vol. LIII, p. 131). Though the solution used by McIlhinney (1941, *Bird-Banding*, XII, p. 171) is the same as the "solution 2" as previously published by Lloyd, both McIlhinney (l.c.) and Ludwig (1942), *Bird-Banding*, XIII, pp. 103-104 appear to have overlooked this reference.—A. L. Rand, National Museum of Canada, Ottawa, Canada.

Chimney Swifts Roosting in Well.—There are few published records of the Chimney Swift, (*Chaetura pelagica*) roosting in wells.

I was informed in the fall of 1940 that a flock of swifts was roosting in a well at Clinton, Georgia but I did not take the story very seriously.

In the late summer of 1941 I was again informed that a flock of swifts was using the same well as a roosting place, so on August 11, 1941, a trip was made to Clinton to check the report. At dusk, a small flock of swifts appeared and dropped into the well which was walled up three feet above the surface of the ground. The well was covered and the following day a trap and collecting cage were placed over it. The explosion of a small fire cracker which was dropped into the well caused the birds to leave the well with the exception of one. Seventy-three swifts were banded and the proportion of 24 adults and 49 young led me to conclude that this flock was composed of adult birds and young that had nested and been raised in the vicinities of Gray and Clinton.

A flock of swifts again used the well as a roosting place the fall of 1942 and on September 7 a trap was set and 100 swifts emerged from the well. Of this number eight had been banded by me in previous years and five (nearly 7%) of the eight banded birds had originally been trapped and banded from the well last year One of the other banded birds had been taken in Milledgeville, Ga. (22 miles away) May 13, 1941 and the other two in Macon, Ga. (12 miles away) during 1940 and 1941.—Raymond J. Fleetwood, Fish and Wildlife Service, Piedmont National Wildlife Refuge, Round Oak, Georgia.

A Belted Kingfisher Recovery.—The only time that I banded any Eastern Belted Kingfishers (*Megaceryle alcyon alcyon*), was on July 2, 1933, when seven nestlings were taken and replaced in the nest after banding. The nest was five feet deep in a bank, and it was necessary to enlarge the entrance to get them. This nest was found by David Fritz, a neighbor, on his father's farm. The nearest fish-inhabited water to this nest is East Lake which is about one-half mile southeast.

At the present time, only one of these has been recovered. This is of No. 210661 which has been reported by O. L. Weber as caught in a trap on September 15, 1933 at a fish hatchery at Stevens Point, Wisconsin. This leads me to believe that the southward migration route of at least some of the kingfishers reared in the eastern part of the upper peninsula of Michigan, is around through Wisconsin, rather than a more direct route across the "Straits."

I did not see these young at the time of hatching, so I do not know their exact age, but I judged them to be about three weeks old by a comparison with figure 195, page 512 of Dayton Stoner's "Ornithology of the Oneida Lake Region: With Reference to the Late Spring and Summer Seasons;" (Bull. New York State College of Forestry, Vol. 4, 1932). By reference again to Dr. Stoner's work, I should estimate that this bird was approximately in its third month at the time of recovery—which shows that the bird had traveled a considerable distance.—Oscar McKinley Bryens, R.F.D. No. 1, McMillan, Luce County, Michigan.

Tree Swallow Mates With Son.—In 1938 the adult Tree Swallows (*Iridoprocne bicolor* (Vieillot)) occupying box No. 3, edge of meadow, were 37–69318, male, banded June 16, 1937, and 38–59917, female, banded June 10, 1938. This pair of birds raised five nestlings. These were banded on June 17, 1938, with bands 38–89818—22.

Except for a record of the finding dead of 38-89818 on June 29, 1938, which must have been very soon after it left the nest, no records were made by members of this brood until June 9, 1942, when 38–89822, male, was trapped in box No. 3, edge of meadow, the same box he was born in. Trapped with him on that date was 38–59917, female, his own mother, who had raised him in the same location four years previously.

This unusual mating resulted in six eggs being laid, five of which ultimately hatched, the young being banded on June 9, 1942.—Edwin A. Mason, Wharton Bird Banding Station, Groton, Massachusetts.

Six-Year Old Tree Swallow.—Returning for the fourth time on June 12 1942, Tree Swallow 37–69318, banded June 16, 1937, as an adult male, automatically records its age as being at least six years.—Edwin A. Mason, Wharton Bird Banding Station, Groton, Massachusetts.

Eight-Year Old Barn Swallow.—Going out after adult Barn Swallows (*Hirundo erythrogaster* Boddaert) at night with flash light and hand net, is always high adventure. The very atmosphere of the becobwebbed barns, silent and dark except for the rhythmic grinding of cattle chewing their cud, occasionally punctuated by the metallic noises of rattled stanchions and halter chains, is strange and uncanny. From your position high above these sounds in the deep darkness near the roof, the un-realness is still further heightened as the piercing beam of a flashlight stabs the blackness to illuminate fluttering forms moving back and forth a few feet over your head. One by one the birds are netted and placed in gathering cages. After repeated check-ups reveal there are no further lurkers in corners and behind beams, the party sits down to band the new birds and record the returns captured. Thus it was that on June 13, 1942, the light of a flashlight made it possible to slowly intone "34–88541." As the age of the bird was realized by the serial prefix, the number was repeated and doubly checked. Banded on July 1, 1935, as an adult female, this bird was at least eight years old when it was taken this year for the sixth time in the same barn it was originally banded in.—Edwin A. Mason, Wharton Bird Banding Station, Groton, Massachusetts.

A Northern Blue Jay in its Ninth Winter.—On December 30, 1934, I trapped and banded a Blue Jay (*Cyanocitta cristata cristata*), at my bird banding station near McMillan, Luce Co., Mich., to which I gave band number 34–333164. The next time this bird was trapped was on December 21, 1942; thus it lacked only nine days of being eight years since the time of banding.

This bird is now in at least its ninth winter, and it is the oldest of the Blue Jays that I have banded up to this time. At my station I have also recovered a Snow Bunting No. L 73527, in its ninth year (see *Bird-Banding*, Oct. 1941).

Of the birds that I have trapped at my station, this Blue Jay holds the record also for the longest period of time between dates of capture, which is nearly eight years. In reading this bird's band number, I noticed that the band was open nearly enough to drop off and that it was very thin. I closed the band and also put a new one (number 41–306629) on the other leg, in case it should be retaken without its first band. It will also be interesting to see how long this old band will last.

At my station the Blue Jay is in 9th place in number banded, at 231; in 6th place in number of repeat records, at 264; in 8th place in number of returns, at 11; and in a tie for 6th place in number of recoveries, at 4.—Oscar McKinley Bryens, R. F. D. No. 1, McMillan, Luce County, Michigan.

A Cedar Waxwing Recovery.—The first time that I banded Cedar Waxwings (*Bombycilla cedrorum*), was on September 6, 1924, when four nestlings were banded and replaced in the nest. Up to the present time, I have banded 44 of this species. I will explain how I caught these. On August 19, 1928, James Harruger was able to take one from its nest by hand; the nest then held three young not over a half day old, and also one egg. I am not sure just what number 40–79855 an adult, (banded June 14, 1940) entered the trap for, as there was neither water nor nestling material in it at that time. Seven adults were trapped with water; and 17 with nesting material, such as strings and wool. All of the others (18), were young taken from the nest and replaced after banding.

Up to the present time, I have never retaken any, and have only one recovery. This is number 36–40438, an adult, banded July 2, 1936. It was reported as found crippled by D. F. Townley, and died March 19, 1937, at Muscogee, Florida. This is my only record of recovery from the State of Florida, and this leads me to conclude that at least some of the Cedar Waxwings which nest in Michigan, winter in Florida.—Oscar McKinley Bryens, R. F. D. No. 1, McMillan, Luce County, Michigan.

Northern Shrike Regurgitates Pellet. An immature of this species (*Lanius b. borealis*) was caught in a trap in which it had killed a Slate-colored Junco (*Junco h. hyemalis*) in the spring of 1939. A regurgitated pellet was observed in the trap after the Shrike had been removed. Including a 10 mm. tip, or tail, the pellet was 10 mm. thick and 40 mm. long. Consisting largely of matted feathers, scattered through the mass could be seen small pieces of bone, some identifiable as from the skull, one tarsus with foot attached, and one fragment of bone obviously from the main body skeletal structure. This observation would indicate that a very brief period of time elapses between ingestion and the regurgitation of indigestible material.—Edwin A. Mason, Wharton Bird Banding Station, Groton, Massachusetts.

A Longevity-Recovery Record of a Slate-colored Junco.—The following data, on file with the U. S. Fish and Wildlife Service, were not included in Miss Cooke's longevity records of Juncos (*Bird-Banding*, Vol. XIII, pp. 177–178). Slate-colored Junco No. F17189 banded at Lenox, Massachusetts on April 7, 1931, was shot on March 5, 1941 at Conway, South Carolina, by R. D. Epps. This bird was at least eleven years old when killed, and so far as I know, this is an extreme record in Junco longevity.—Maurice Broun, Hawk Mountain Sanctuary, Orwigsburg, Penna.

On a Case of Reversed Migration.—The case of "reversed migration" reported in the October *Bird-Banding* (XIII, p. 182) by Wendell P. Smith, where a Song Sparrow banded at Wells River, Vt. April 16, was recovered at East Jaffrey, N. H., some 90 miles to the south the June 19 following, is of considerable interest when fitted into the facts and hypotheses which make up my concept of the general pattern of migration.

The Song Sparrow, like many other birds, seems to migrate not in a haphazard north-south direction but toward definite circumscribed breeding or wintering areas as the case may be, wherein it can and frequently does return to the exact

station it occupied the year before. It also appears that where summer and winter areas are well separated, the course the individual bird of such species takes between them, varies.

This Song Sparrow would have had the status of a summer resident at East Jaffrey on June 19, and when it (presumably) came from further south in April, the East Jaffrey area was probably its objective anyway. That is it overshot the mark up the Connecticut Valley flyway.

Evidence has led me to believe that spring migrants not infrequently do overshoot the mark. The appearance in the New York region of stragglers of such early species as Robin and Grackle well ahead of any general arrival, is frequently correlated in date with a general movement of the respective species further south; and there are occasional very early dates here for late arriving species (which also breed in the South), such as Kingbird and Indigo Bunting, that correspond to their normal arrival in the South. The spring migration records here of such species as Blue-gray Gnatcatcher and Yellow-throated Warbler are most easily so explained.

Excepting this last group, I have had no opinion as to whether the birds mentioned were actually north of their breeding area objective, or merely out of time; or as to whether if nor h of, they would return to it. There seems no reason why they should not do so, as migrants certainly direct their course by something (so far quite unknown), other than or in addition to the compass.

There is a complication which may have had a bearing on the case of the Song Sparrow (No. 39-168058) in question. Wells River, in the Connecticut Valley, is in fact some 90 miles north of East Jaffrey, in the hills, but presumably not so faunally.—J. T. Nichols, New York, N. Y.

RECENT LITERATURE

Reviews by Donald S. Farner

BANDING

1. Bird-Banding by the Museum of Natural History of Göteborg in 1940. (Göteborgs Naturhistorika Museums ringmarkingär av Flyttfåglar under 941.) L. A. Jägersköld. 1942. Göteborgs Musei Arstryck 1942: 70–90. In 1941 7,917 birds in 126 species were banded making a total of 121,961 birds in 205 species banded since 1911. There have been 4,065 (3.3 percent) recoveries and returns since 1911. Individual recovery and return records for 1941 are given. An interesting record is that of a Fieldfare, *Turdus pilaris* L., recovered June 1, 1941 at the place where it was banded as a young bird June 8, 1939. Species banded in greatest numbers in 1941 were: Black-headed Gull, *Larus ridibundus* L. (464); Common Tern, *Sterna hirundo* L. (232); "Kentsk" Tern, *S. cantiaca* Gmel. (205); Starling, *Sturnus vulgaris* L. (518); Yellow Bunting, *Emberiza citronella* L. (326); Gray Flycatcher, *Muscicapa atricapilla* L. (776); Great Titmouse, *Parus major* L. (800); House Martin, *Chelidonaria urbica* (L.) (729).

2. Bird Study through Banding.—Dayton Stoner. 1942. *The Scientific Monthly*, 55: 132–138. This little paper is packed with interesting information about the Bank Swallow, *Riparia riparia riparia* (L.). Since 1923 6,834 individuals were banded and 247 returns recorded. The "homing instinct" is well marked. No recovery was made more than 12 miles from the point of banding. Most recoveries were made in the colony in which the birds were banded. Several

birds were captured in the two nesting seasons following the season in which they were banded; one was captured as a return in three successive nesting seasons. Burrows are excavated at the rate of three-quarter inches per day. There is evidence of both polygamy and polyandry. Average clutch is 4–5; average weight of the eggs is 1.4 grams; incubation requires 14–16 days and is shared by both parents. The young attain their maximum weight, 16.5–19.5 grams, at 13–16 days and attempt their first flight at 19–21 days. The average weight of adult birds is 14.3 grams (range—11.8–20.3). Body temperature varies from 90° F.–112° F. (mean—107.4° F.); from 90° F.–115° F. in the young. Principal destructive agents are skunks, foxes, brown rats, and sliding banks.

MIGRATION

3. The Distribution and Migration of the Hudsonian Curlew.—P. A. Taverner. 1942. The Wilson Bulletin, 54: 3–11. "There are two distinct populations of the Hudsonian Curlew, *Phaeopus hudsonicus* Latham, breeding, migrating, and wintering on opposite sides of the American continents." The western population migrates up and down the Pacific coast while the eastern group migrates up the Atlantic coast to New Jersey and thence northward to Hudson Bay. It is suggested that the complete separation of these two population is recent since no racial distinction can be detected between them.

ECOLOGY AND POPULATION STUDIES

4. Guano Birds. (Aves Guaneras).—William Vogt. 1942. *Boletin de la Compañia Administradora de Guano*, 18 (3). 132 pp. The results of a three-year ecological investigation of guano-producing birds of the Peruvian coastal islands. There are three species which produce guano in appreciable quantities: a cormorant, *Phalacrocorax bougainvillii;* a booby, *Sula variegata;* and a pelican, *Pelecanus occidentalis thagus*. The cormorant nests in microclimates of mildly high temperatures and is completely dependent on the anchovy for food. The boobies nest either on cliffs or on level places in warmer microclimates but may compete with the cormorants for nesting sites. They are not as dependent upon the anchovy for food. This species has declined steadily since 1919 when it was the most abundant guano-producer. The reason for the decline is not known although it is correlated with the shift of the nesting population from the level places to the cliffs as the level nesting sites have been taken over by the cormorants. The pelican, a species of tropical origin, can breed in microclimates of high temperatures. It can feed on fish which are larger than the anchovy. Most of the observations were made on the cormorant since it produces the bulk of the guano and is the most numerous of the three species. Each bird produces 15.8 kg. guano per year. Using this figure and the annual harvest data of the Guano Administration it was possible to estimate the populations for previous years. It was found that there has been a gradual increase in population under the Guano Administration. The data also revealed the operation of a seven-year population cycle. There were maxima in 1910 (4 million birds), 1917 (5 million), 1924 (9 million), 1933 (10 million), and 1938 (11 million). Minima occurred in 1912 (2.5 million), 1919 (3.0 million), 1926 (5 million), 1931 (6 million), 1935 (8 million), and 1940 (8 million). The anomalous 1933 maximum and 1931 and 1935 minima are possibly to be attributed to "a temporary change in management." Minima can be correlated with climatic disorders recorded in 1911, 1918, 1925, and 1939. These disturbances are characterized as periods of unusual amounts of west wind, abnormally high ocean temperatures, and unusual amounts of rainfall. A decrease in phytoplankton and zooplankton with an accompanying decrease in the anchovy population doubtlessly results from these climatic disturbances. Cormorants because of lack of sufficient food supply then abandoned nests in large numbers with a consequent decline in population. Cormorants spend one month in courtship, about one month in

laying and incubating, and two months rearing young. Incubation lasts 27 days and is shared by both parents. Although nests can be found during all months of the year the greatest number is to be found in November just preceding the period of greatest abundance of anchovy (December and January), an interesting adaptation of the reproductive cycle to the cycle of food availability. Suitable locations contain an average of 314 nests per 100 sq. km. The mean clutch is 3.13 ± 0.101. Eggs are laid at two day intervals. Both parents carry food to the young. However food is always carried to the nesting site rather than to the bird's own young so that the rearing of the young is actually a communal process. This paper is a contribution of unusual significance to avian ecology.

5. Sex Ratios in Winter Duck Flocks.—R. C. Homes. 1942. *British Birds*, 36: 42–49. Winter flocks were observed and counted at London, Warwicks, Oxon, and Lanarks periodically from October, 1938 to March 1939. The numbers of each sex and the numbers of birds which could not be sexed by field observation were recorded for each flock. Results (condensed) for species in which significant numbers were observed are as follows: Mallard, *Anas platyrhynchas platyrhynchos* L., 21,723 observed, 52 per cent males, percentage of males by flocks varied from 48–62. Teal, *Anas crecca crecca* L., 3,205 observed, 58 per cent males, percentage of males by flocks varied from 52–62. Wigeon, *Anas penelope* L , 3,037 observed, 55 per cent males, percentage of males by flocks varied from 52–60. Common Pochard, *Aythya ferina ferina* L., 4,712 observed, 60 per cent males, percentage of males by flocks varied from 51–76. Tufted Duck, *Aythya fuligula* (L.,) 16,343 observed, 56 per cent males, percentage of males by flocks varied from 45–69. The numbers of birds included in the above totals which could not be sexed were: Mallard (5,032), Teal (1,005), Wigeon (677), Common Pochard (197), and Tufted Duck (1,901). It would seem that there is a possibility that these unsexed birds could be of a greater percentage of females, thereby introducing some error into the calculations of sex ratios.

6. Lyrebirds of Sherbrooke.—A. G. Cambell and Alexander Gray. 1942. *Emu*, 42 (Part 2): 106–111. The Sherbrooke portion (about 2,000 acres) of the Dandenong State Forest near Melbourne contained 20 nesting pairs of Lyrebirds (*Menura superba*), in 1941. A map shows the locations of the nests with reference to the habitats.

REPRODUCTION

7. The Seasons in a Tropical Rain-forest (New Hebrides). Part 5. Birds.—Journal of the London Linnean Society. *Zoology*, 41: 50–70. This study is concerned primarily with the Golden-Whistler, *Pachycephala pectoralis*, a non-migratory species widely distributed throughout the East Indies and Australia. Its altitudinal range is from sea level to 3,800 feet. The recognition of insular races is based on differences in the plumage of the females since males show no differentiation. The nest is constructed by the female only but both parents incubate and feed the young. The young leave the nest after 11 days. The breeding season is in June and July. Testes attain their maximum weight in the period from May to July; the greatest number of large oocytes in the ovaries occurs in May and June. This maximum development of the gonads therefore occurs in the period of *decreasing and minimum amounts of daylight*. However, in the same species in Australia the breeding season occurs in the period of *increasing and maximum amounts of daylight*. In the New Hebrides the nesting season is in the "dry season" whereas in Australia it is in the "wet season." In the New Hebrides the mean daily temperature varies only 3° C. throughout the year and cannot be regarded as a factor in the regulation of the reproductive cycle. There are no

periodic changes in type and quantity of food available or in feeding habits. In the New Guinea population of this species there is no periodic nesting, nests being found throughout the year. With changes in daylight, temperature, food, and rainfall apparently eliminated the author makes no suggestions as to possible factor which may stimulate the development of the gonads.

8. Notes on the Nesting Habits of the American Robin (Turdus migratorius L.).—Joseph C. Howell. 1942. *The American Midland Naturalist*, 28: 529–599. An extensive series of observations made at Ithaca, N. Y. Both sexes return to the same region to nest each year. The male appears to select the nesting territory. The nesting territory may vary considerably in size. When it is small the parents obtain food elsewhere, frequently in a common feeding ground. The territory is defended against other members of the species. The female is the more energetic defender of the nest itself. "In the courtship of the Robin both voice and display are important. While displaying the male spreads and and elevates his tail, shakes his wings, and inflates his throat. Both the display and the mating usually occur on the ground." One case of polygamy in which two females shared a nest is recorded. Both members of the pair influence the selection of the nesting site. The nest is usually built by the female. Early in the season the time required for the building of the nest is five or six days; the later nests are built in two or three days. Occasionally a pair will use the same nest twice during the season. "The Robin usually lays three or four eggs, four being the commoner number in the earlier part of the nesting season." Experiments involving removal of eggs failed to stimulate the laying of more than the average clutch. Average measurements of eggs were 28.4 mm. x 20.7 mm. Average weight, fresh, was 6.26 grams. When a nest with eggs is destroyed another is built and another clutch of eggs layed within 10 days. The female alone performs the incubation which lasts "usually" 13 days. Both parents feed the young. Both share in the removal of excrement which is either eaten or carried some distance from the nest and dropped. Food of the young is largely (70 per cent) animal matter. The young remain in the nest from 9–16 days. Usually two (rarely three broods are raised during a season. Pairs may remain intact for the season. Testes and ovaries attain maximum development during the first week in May. Thirty-two per cent of the first nestings in 1937 were successful (one or more young raised); 38 per cent of the first nests in 1938 were successful. Second nestings in 1937 were 75 per cent successful. Each pair raised 3.9 young per season (1.3 young per nest), a rather high reproductive rate for a passerine species. It is difficult to gauge the significance of some of the observations recorded because the number of birds involved is not stated.

9. Barking Owl (Rather than "Winking Owl"). Record of Nesting Habits.—David Fleay. 1942. *Emu*, 42 (Part 1): 25–30. In this species, *Ninox connivens*, the male is larger than the female and possesses a deeper voice. Observations were made on the nesting habits of a pair held in captivity. The male scooped out a depression in a hollow log which was used as a nest. The female laid the first egg on July 24 and started incubation immediately. The second and third eggs were laid at intervals of three and six days respectively after laying of the first. The female remained on the nest continuously after the start of incubation and the male became "extraordinarily savage." The owlets were hatched at three-day intervals beginning August 30, making the incubation period 37 days. At the age of four months the young had developed adult plumage.

10. Incubation of the Spotted Nightjar.—P. A. Bourke. 1942. *Emu*, 42 (Part 1): 44–48. This paper contains some interesting observations on behaviour of nesting birds of this species, *Eurostopodus guttatus*. Among these observations

is that of a bird which was disturbed while on the nest: "She (?) then flushed suddenly and silently, flew some twenty feet away and settled on the ground, where she took several steps before squatting in a peculiar position with lowered head and with the tail-tip raised until it was about six inches from the ground. In that position she exactly resembled a piece of broken branch, . . ." The incubation period is stated to be at least 33 days. Another bird when disturbed while on the nest "alighted only a few steps away, turned towards me, opened her bill, and elevated her spotted wings in a manner reminiscent of an alighting tern."

11. Whero. Island Home of Petrels and Other Birds.—L. E. Richdale. 1942. *Emu*, 42 (Part 2): 85–105. This small rocky island lies near Stewart Island which is the most southern island in New Zealand. It is the nesting place of Skuas (*Catharacta skua lonnbergi*); White-faced Storm-Petrel (*Pelagodroma marina*); Diving Petrel (*Pelecanoides urinatrix*); Mutton-Bird (*Puffinus griseus*); Whale-Bird (*Pachyptila vittata*); and Narrow-billed Prion (*Pachyptila turtur*). The population for the island for the 1940–1941 season by species was estimated to be: Skuas, 2 (1 pair); Mutton-birds, 400; Storm Petrels, 1,200; Whale-birds, 50; Narrow-billed Prions, 400; Diving Petrels, 200. The area of the island is about 0.75 acres. All birds except the Skuas disappear during the day. During the midsummer the Mutton-birds return first at night arriving between 9–10 P.M. Diving Petrels arrive between 10 P.M. and midnight. At 10:15 P.M. the first Storm Petrels and Narrow-billed Prions return. By 2:30 A.M. Storm Petrels and Narrow-billed Prions leave the island. Courtship activities of the Mutton-birds last from 2–4 A.M. at which time they depart. The Diving Petrels leave about 3 A.M. Observations of interest are the hatching of an egg despite four days' desertion during incubation (Mutton-bird) as well as a period of 13 days of continuous incubation without relief by one Mutton-bird. Occasionally young Mutton-birds were allowed to go for two days without feeding.

PHYSIOLOGY

12. Concerning the Development of Temperature Regulation in Various Nestling Birds. (Ueber die Entwicklung der Temperaturregulation bei verschiedenen Nesthockern.)—Alfred Boni, *Schweizerischen Archiv für Ornithologie* 2, 1942: 1–58. A comparative study was made at the University of Basel of the rate of development of the physiological mechanism for regulating body temperature in three species of altricial birds: *Melopsittacus undulatus*, a parrot; *Jynx t. torquilla*, a woodpecker; and *Lanius c. collurio*, a shrike. All body temperatures were taken rectally by thermocouples, and the birds were exposed to various air temperatures from 99° to 67° F. until their body temperatures reached an equilibrium.

All three species were of approximately the same size (33–37 gms.). Nestling parrots were obtained from a zoo, the other birds from wild nests. The effective ages of the nestling woodpeckers and parrots were determined by comparing their stage of growth with a normal growth curve for the species, and these effective ages were used rather than the actual ages, which were often unknown. The same nestling was often used more than once with intervening rest periods of two or more days in the nest. These factors lend some doubt on the accuracy of the comparisons made between species as to the time of temperature development.

All species were essentially cold-blooded in their temperature reactions at hatching, their body temperatures being only a few tenths of a degree above that of the air. Even in a precocial species, *Coturnix c. coturnix*, a quail, body temperatures at hatching were found to vary considerably with fluctuations in air temperature. At 72° F. air temperature, the development of ability to maintain constant body temperatures occurred most rapidly in the shrike between the 2nd and 11th days after hatching, in the parrot between the 3d and 11th days, and in

the woodpecker between the 3d and the 12th–13th days. For comparison, this period in the house wren, *Troglodytes aedon*, occurs between the 3d and 9th days. Regulation of body temperature developed earliest at high air temperatures and at later ages for lower and lower air temperatures. Both adult and nestling birds were sensitive to high temperatures above 93°–97° F., when the relative humidity was 70%. The greater intolerance of the woodpecker to these high temperatures is correlated with its inability to increase the rate of breathing more than 150 times per minute, while with the other species this rate could be increased to 300 times per minute. Panting first occurred in the parrot at 6 days of age. The rate of breathing was lowest in the parrot between 84° and 93° F. and increased not only with rise in air temperature, but, after temperature regulation became eetablishd, increased also with a drop in air temperature.

Activity tended to lower the body temperature of nestlings 4 days of age and older, at the lower temperatures. At low air temperatures the birds bunched together in the nest to conserve heat, but at high temperatures they separated as far as possible to give the maximum surface for its dissipation.

Concerning factors involved in the regulating mechanism, it is demonstrated that the warm-blooded condition will develop even in the denuded bird although at a slower rate; so feathers are not absolutely necessary. Other factors are mentioned but not discussed.

The paper is a valuable contribution to our knowledge of the temperature limits to which nestling birds are adjusted and to the rate and manner in which temperature regulation develops, but adds no important new information in the analysis of the physiological mechanisms involved.—S. Charles Kendeigh.

13. Muscle Tremors and the Development of Temperature Regulation in Birds.—Eugene P. Odum. 1942. *The American Journal of Physiology*, 136: 618–622. The young of the House Wren, *Troglodytes aedon aedon* Vieillot and the Black-capped Chickadee, *Penthestes atricapillus atricapillus* (L.) are poikilothermic at three days. At this stage there is no thermal regulation; there are no muscle tremors; and heart rate is directly proportional with the temperature of the environment. With the development of homoiothermy, muscle tremors occur when the environmental temperature is lowered; heart rate becomes inversely proportional to temperature. With decreasing temperature periods of tremors become more frequent until steady shivering occurs. "The muscle tremor heat production mechanism apparently develops more rapidly at first than does the control of heat loss indicated by feather growth." It is stated that preliminary experiments with the precocial species the Ring-necked Pheasant, *Phasianus colchicus colchicus* (L.), reveal muscle tremors as early as the ninth day of incubation when the temperature is lowered to 37.2° C.

BEHAVIOUR

14. The Winter Flocking of the Pied Currawong.—N. L. Roberts. 1942. *Emu*, 42 (Part 1): 17–24. Although the interpretations in this paper are sometimes anthropomorphic it nevertheless contains some interesting observations. Among the interesting habits of the flocks of this species, *Strepera gracula*, is that of "tweaking," the snapping off of twigs and small branches from trees and allowing them merely to fall to the ground. Of interest also are the observations on "topping the tree" in which one bird occupies the topmost branch of a tree until another dives or tumbles on him and then replaces him. The new occupant remains on the branch until displaced in a similar manner by another member of the flock. Pairing begins in early August while the birds are still in flocks.

HEREDITY, VARIATION, AND EVOLUTION

15. Quantitative Studies in the Geographical Variations in Birds.—

The Common Guillemot (Uria aalge Pont.).—H. N. Southern, 1941. Proceedings of the Zoological Society, Series A, 111: 255–276. The bridled form of this species is stated to be a single factor mutant which is present in varying proportions in the North Atlantic colonies. The proportion of the bridled form increases from south to north (less than 2 per cent in southern England, 15 per cent in northern Scotland, more than 50 per cent in northern Norway and in Iceland) and in a lesser degree from east to west. This is well substantiated with statistically analyzed counts. It is suggested that this distribution is due to the unimpeded spread of an advantageous mutation or that a balanced conditicn has been reached due to "counter-selection" at various levels by environmental factors. The data appear neither to support nor deny either of the suggestions.

16. Adaptive Modifications for Tree-Trunk Foraging in Birds.—Frank Richardson. 1942. University of California Publications in Zoology, 46: 317–368. $0.75. Quantitative comparative anatomical studies were made with the following species with the object of demonstrating tree-climbing modifications: Downy Woodpecker (*Dryobates pubescens*); Barred Woodhewer (*Dendrocolaptes certhia* White-breasted Nuthatch (*Sitta carolinensis*); Brown Creeper (*Certhia familiaris*) and Bewick Wren (*Thyomanes bewickii*). In these species there are only a few common adaptations such as the shifting of the insertions of the iliofibularis and tibialis anterior muscles and the increased size of the latter. The species which use the tail for support show in common such adaptations as the strengthening of the shafts and rami of the supporting retrices and increased size of the pygostyle and caudal vertebrae. There are many excellent and well-chosen tables, diagrams, and drawings.

17. Archaeopteryx, an Ancestor of the Birds. (L'Archéoptéryx, Un ancêtre Oiseaux.)—A. Reichel. 1941. Nos Oiseaux, 159: 93–107. A description of the anatomy of this interesting fossil with some suggestion concerning the nature of its biology and ecology.

BOOKS AND MONOGRAPHS

18. The Ivory-billed Woodpecker.—James T. Tanner. 1942. Research Report No. 1 of the National Audubon Society, 1006 Fifth Avenue, New York, N. Y 111 pp,, $2.50. A personal examination of 45 different areas by the author was made to determine the present distribution and status of the Ivory-billed Woodpecker (*Campephilus principalis* (L.)). This survey together with careful observations of the birds in the Singer Tract, Madison Parish, Louisiana required 21 months of intensive work in the field. It was concluded that six separate areas probably still contain Ivory-bills. The estimated population for all areas in 1939 was 22 individuals. The population of the Singer tract has undergone a gradual decrease to a total of six individuals in 1939. More than 150 records and reports were critically examined in order to prepare maps of the original distribution of the species. The Ivory-bill does not seem to be linked to any single type of habitat. In the bottomlands and in the Mississippi Delta region it was always associated with virgin stands containing sweet gum and various oaks. However in Florida the birds showed a wide tolerance of habitats. Ivory-bill habitats are always characterized by an abundance of other woodpeckers such as the Pileated and the Red-bellied. The food of the Ivory-bill consists largely of wood-boring larvae (Cerambycidae, Buprestidae, and Elateridae). These are secured by *scaling* the bark from trees (usually one foot or more in diameter) which have been dead less than two years, The Ivory-bill rarely *bores* for food. Hence the presence of relatively large numbers of recently dead trees of sufficient size may be the determing factor in Ivory-bill habitats. Seeds, nuts and berries are unimportant food items. The Ivory-bill has no competitors for its food supply. The disappearance of the species can be correlated with the removal of virgin timber by logging operations.

The maximum density of the species was probably one pair per six square miles. Ivory-bills probably remain sedentary until the food supply decreases causing them to wander elsewhere. Ivory-bills breed from January to May. A second nesting may occur if the first nest is broken up. Average clutch is 2.9. Incubation time is probably 20 days. Young probably stay in the nest for five weeks. Both parents carry food to the young. The male cleans the nest. Young are fed by the parents for about two months after they leave the nest. Six nests were observed in the Singer tract. Average number of young per nest was 2.1. Three of the six nests were successful. One young was raised in each. The author apparently believes that the species can be preserved in spite of its present low ebb. The areas which are recommended as possible Ivory-bill refuges are the Singer tract in Louisiana, the Big Cyprus area in Florida, the Apalachicola River Swamp in northwestern Florida, and the Santee River Swamp in South Carolina. In spite of the lack of adequate quantitative data, now impossible to obtain, this report is a most significant contribution to the science of ornithology.

19. The Roseate Spoonbill.—Robert Porter Allen. 1942. Research Report No. 2 of the National Audubon Society, 1006 Fifth Avenue, New York, N. Y. 142 pp. $2.50. This report summarizes an investigation of 25 months augmented by an excellent fund of previous experience with the Roseate Spoonbill (*Ajaia ajaja* (L.)). The present range of this species extends from Sonora and the coast of Texas, Louisiana and Florida south to lCochagua, Chile and the pampas in the Province of Buenos Aires in Argentina. There are at present eight nesting localities in the United States; five in Texas, one in Louis ana, and two in Florida (both insular). Except for the absence of the species from much of the southern Florida mainland and a portion of Louisiana its present distribution is probably very similar to the original distribution which existed up to 1860–1865. From 1865–1890 the Roseate Spoonbill virtually disappeared from its entire range in the United States due to its destruction by plume-hunters and settlers. From 1890–1919 there were probably no more than three small colonies of breeding birds with a total of 25 pairs. There were no breeding birds in Texas. The recovery in the Texas-Louisiana Region (1921–1940) to numbers possibly approx mating the original population was due to protective measures and possibly to the flourishing Mexican colonies. The non-recovery of Florida populations in spite of protection may be due to the present diminished status of Cuban and South American colonies. In 1941 there were about 5,000 individuals in the United States, 89 per cent of which were in the Texas-Louisiana Reg on. At least 3,500 of the 5,000 were non-breeding birds (mostly immature) which had migrated northward from southern colonies after the breeding season. Spring migrations of breeding birds into Louisiana and Texas occur in February and March. Summer flocks of non-breeding birds arrive in May and June. Fall migration is diffuse. Two incoming migrations of breeding birds occur in Florida; a spring migration in April and May to the mainland (small and perhaps non-existent some years), and a fall migration in November to Florida Bay (about 30 birds per year). A large spring migration of non-breeding birds (99 per cent juvenile) arrives in Florida in November from the south. Breeding cycle behavior is divided as follows: (1) *Preparing phase* characterized by activity of the flock as a whole in "sky-gazing" and concerted "up-flights." (2) *Prenuptial phase* in which males begin to defend territories and in which pairing occurs. (3) *Copulation and Nest-building phase*. Male brings nesting material to the female who does the actual building. (4) *Incubation phase*. Average clutch is 2.7. Incubation time is 23–24 days. Both sexes incubate. Nest relief occurs three or four times during the daylight hours. (5) *Hatching and Caring for Young*. The principal predators, grackles and raccoons, are probably detrimental only to small colonies. The concerted action of spoonbill colonies in response to slight disturbances may result in mass

desertion of nests. Spoonbills may be driven from their nesting territories by herons and egrets. This species requires shallow water with a minimum of tidal fluctuation in the neighborhood of the nests and roosts. This provides food as well as a temporary habitat for the young after they leave the nest. Although sufficient quantitative data are lacking it is obvious that food consists largely of minnows and other small fish. Aquatic insects and crustaceans are items of considerable importance. Mollusks and plants are unimportant as food. One partial and three complete moults in the course of 32 months occur in acquiring adult plumage. Adults molt twice a year. Temporal relationships of molts in the Florida and Texas-Louisiana populations are explained in excellent diagrams. Ectoparasites described as "seed-ticks" or mites should have been identified. A combining of Parts I (Distribution) and II (Abundance) would have avoided duplication and might be of advantage to the reader. The establishment of a colony of White Spoonbills (*Platea'a leucordia* L.) in Muy, Holland, under protected conditions (1924–1939) as described by Van Oordt appears to be comparable to the re-establishment of the Texas-Louisiana colonies and should have been cited. Suggestions made for further research and for the preservation and increasing of the present population appear to be sound and logical.

20. Summer Birds of the Allegany State Park.—Aretas A. Saunders. New York State Museum Handbook 18. The University of the State of New York Press. 1942. 313 pp. $0.50. This usable little book was prepared primarily for students of the Allegany School of Natural History. It contains a section describing the habitats of the region, a useful key, suggestions for field identification, and descriptions of all birds recorded from the region. It is the result of experience in field teaching in ornithology and is a useful contribution to the technique of teaching birds.

21. Distribution and Variation of the Horned Larks (Otocoris alpestris) of Western North America.—William H. Behle. 1942. University of California Publications in Zoology, 46: 205 316. $1.25. This paper is devoted principally to a revision of this variable species in which fourteen western subspecies are recognized, described, and mapped. In addition to this, a definite contribution to the biology of geographical variation and distribution is made.

22. Bird Display. An Introduction to the Study of Bird Psychology.—Edward A. Armstrong. 1942. Cambridge at the University Press. New York. Macmillan. 381 pp. $5.50. This book with its vast array of references—some 600—describes display in many birds and points out "similarities of behaviour of birds and other creatures varying from insects and fishes to man." Aristotle and Pliny are cited, and the text is enlivened at places by quotations from the poets. Many books suffer from a lack of documentation; in this case the author has erred in the opposite direction. He is too uncritical in regard to his sources: he draws conclusions from descriptions from novels and books of adventure (p. 185), althoughregretting that "we are not told how the sexes were assorted in this dance" of the non-sexually dimorphic Whooping Crane; he quotes as fact Schjelderup-Ebbe's unfounded assertions of rigid peck order in large numbers of species (p. 171) and his fable of the despotism of the hen sparrow towards her wooer with consequent race suicide (p. 175); he devotes considerable space to Verrill's "Strange Birds and Their Stories," although characterizing one account as "rather vague and doubtful" (p. 231). Occasionally there is carelessness: some of Tinbergen's ideas are assigned to Davis (p. 249); Muscovy Duck actions are attributed to geese (p. 250); while surprising statements (p. 177) and general conclusions (p. 253) are given on the authority of Rothschild (1941), the reference in the bibliography being "personal communication."

The book consists of a great number of anecdotes to which some theoretica remarks on "behaviour complexes" are tacked. "We may conclude that nest-building arose through emotion seeking and finding an outlet in ways which were at first aimless or destructive; but even the venting of spite on the harmless grass may be formalised so that it becomes valuable in assisting the survival of the species" (p. 28). Injury feigning is apparently considered as due to "conflicting or thwarted impulses" (p. 86). It is suggested that "elaborate sexual display and 'injury-feigning' . . . have been built up from the begging movements of chicks — further confirmation of our theory that many display-patterns have evolved from attitudes of the hungry young" (p. 85).

Although references are made to much of the most important recent work in the field, the reviewer feels that no sure foundation is laid in this "Introduction to the Study of Bird Behaviour", that the general effect is confusing and that the book does not merit its sub-title. There are indices to Birds and Other Organisms, to Subjects and to Authors, and a list of scientific names arranged by families, besides 22 plates showing photographs of birds in various displays.—M. M. Nice.

Griffin "Homing experiments with herring gulls and common terns."

ANNOUNCEMENT

Bird-Banding takes pleasure in announcing the appointment of Dr. Donald S. Farner as Associate Editor to replace Mrs. Margaret Morse Nice, resigned. It has not been possible for Dr. Farner to cover all the literature accumulated in the interval between Mrs. Nice's resignation and his acceptance of the Associate Editorship, but it is hoped to bring the abstracting up to date in succeeding issues.

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